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ADMINISTRATION REPORTS OF

THE AGRICULTURAL CHEMIST ENTOMOLOGIST AND MYCOLOGIST

OF THE

DEPARTMENT OF AGRICULTURE, MADRAS

(DETAILED REPORT)

1939-40

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ADMINISTRATION REPORT OF THE GOVERNMENT AGRICULTURAL CHEMIST FOR THE YEAR 1939–40.

I submit herewith the detailed report of my section for the year 1939-40 (fasli).

I was in charge of the section throughout the year.

The work of the section is reported on under three major heads : (i) General including analytical and advisory work, (ii) Teaching and (iii) Research in soil science, manuring, plant and animal nutrition, microbiology and agricultural industries.

I. General.

Meteorology.—Records of the climatological conditions at 8·00 hours were recorded daily at the Observatory of the Agricultural Research Institute under my control. A monthly weather review of rainfall, received, was compiled from reports from the Agricultural Research Stations in the Presidency and from extracts from the Indian Daily Weather Reports published by the Indian Meteorological department at Poona, and published in the *Madras Agricultural Journal.* The Table below gives a summary of observations recorded at the Agricultural Research Institute for 1939–40 (1st April 1939 to 31st March 1940), 1939–40 :—

Annual Weather Report.

Year and month.	Temperatures.						Relative humidity.		
	Absolute maximum in shade.	Absolute minimum in shade.	Mean maximum in shade.	Departure from normal.	Mean minimum in shade.	Departure from normal.	For the month at 8 hours.	Mean for the month.	Departure from normal.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	°F	°F	°F	°F	°F	°F	PER CENT.	PER CENT.	PER CENT.
1939—									
April ..	99·5	63·8	94·4	— 1·2	72·0	— 1·0	73·5	71·1	+ 3·4
May	98·5	68·5	95·9	+ 0·9	74·0	Nil.	67·9	70·2	— 2·3
June	98·5	70·0	90·5	+ 1·5	73·6	+ 0·5	64·8	69·5	— 4·7
July	91·0	70·0	86·3	— 0·8	72·7	+ 0·7	67·1	74·0	— 6·9
August ..	92·0	66·5	86·6	— 0·3	72·6	+ 1·5	70·7	74·0	— 3·3
September ..	92·0	66·0	88·8	— 0·7	70·8	+ 0·3	76·0	73·5	+ 2·5
October ..	91·0	64·0	87·7	+ 0·2	70·7	+ 0·3	82·8	79·9	+ 2·9
November ..	86·3	63·5	83·1	— 1·4	68·9	+ 0·4	84·6	80·6	+ 4·0
December ..	87·0	56·2	83·8	Nil.	64·9	— 0·2	75·0	78·8	— 3·8
1940—									
January ..	87·0	53·0	83·3	— 2·6	62·8	— 1·4	73·4	76·2	— 2·8
February ..	92·8	58·0	89·9	— 0·6	63·8	— 2·0	73·1	71·9	+ 1·2
March ..	98·0	63·0	94·6	— 0·2	68·3	— 1·4	64·1	69·7	— 5·6

Annual Weather Report, 1939–40—cont.

Year and month.	Rainfall. Actual for the month. (11)	Rainfall. Mean for the month. (12)	Rainfall. Departure from normal. (13)	Number of rainy days. (14)	Wind velocity. Average for the month. (15)	Wind velocity. Mean. (16)	Wind velocity. Departure from normal. (17)
1939—	INCHES.	INCHES.	INCHES.		M.P.H.	M.P.H.	M.P.H.
April	1·10	1·90	— 0·8	2	2·3	2·6	— 0·3
May	0·63	2·63	— 2·0	4	3·6	3·6	Nil.
June	0·08	1·48	— 1·4	Nil.	7·0	7·4	— 0·4
July	1·30	1·30	Nil.	3	7·8	7·0	+ 0·8
August	3·10	1·20	+ 1·9	6	7·0	7·0	Nil.
September ..	0·90	1·80	— 0·9	3	3·5	5·3	— 1·8
October	12·18	5·68	+ 6·5	12	1·6	2·8	— 1·2
November ..	4·81	4·81	Nil.	6	0·8	2·2	— 1·4
December ..	Nil.	1·50	— 1·5	Nil.	1·0	3·0	— 2·0
1940—							
January	Nil.	0·70	— 0·7	Nil.	1·6	3·0	— 1·4
February ..	Nil.	0·50	— 0·5	Nil.	1·9	2·8	— 0·9
March	0·20	0·80	— 0·6	1	1·5	2·7	— 1·2
Total ..	24·30	24·30	Nil.				

The rainfall for the year was just normal after a series of years of deficit rainfall, but the distribution was not normal. The rainfall from April-June was in large defect, while that for July was normal and for August above normal. The bulk of the rainfall for the year was received in October 1939 when 12·18 inches were recorded on 12 rainy days or more than double the normal, and nearly half the whole year's rainfall. The rainfall of November 1939 was normal and thereafter no rains fell till late in March 1940.

The other climatic elements were about normal. The heavy rainfall of October and early November was the most favourable feature of the year's climatology.

Analytical and Advisory.—Table below is a statement of the number of samples, the kind of samples and origin from which they were received, analysed during the year :—

Particulars.	Research.	Agricultural Department.	Other Government departments.	Ryots and private parties.	U.P.A.S.I.	Total.
Soils	159	200	79	..	1	439
Manures and composts ..	118	41	..	15	20	194
Waters	53	19	3	..	..	75
Foods and fodders ..	190	3	121	..	..	314
Cane juices	..	528	10	1	..	539
Field experiments ..	69	..	..	..	..	69
Miscellaneous	3	38	5	1	..	47
Total ..	592	829	218	17	21	1,677
Total for 1938–39 ..	588	1,651	172	29	4	2,454
Total for 1937–38 ..	560	1,722	225	28	9	2,544
Total for 1936–37 ..	177	1,509	134	34	10	1,864

A sum of Rs. 348–8–0 was received as analytical fees, comprising Rs. 202–8–0 from the United Planters Association of South India for analysis conducted for its members and Rs. 146 from ryots and other private parties. The receipt for the two previous years were Rs. 231–8–0 for 1938–39 and Rs. 360 for 1937–38.

As in previous years, the section, in addition to carrying out analysis of agricultural products and sending reports of a routine nature, dealt with numerous enquiries for advice on matters connected with soils, manures, cattlefoods and human foods from officers of the Agricultural department and also of the other Government departments (i.e.), Jail, Public Health and Public Works departments.

Of the samples received and analysed, the following is a summary of results of samples of importance :—

(1) The Assistant Director of Agriculture, Cuddapah, sent a sample of acid treated cotton seed and a sample of jonna preserved with naphthalene and wanted to know if these could be used as cattle feed. Their general feeding values were quite good as could be seen from the following data :—

Particulars.	Cotton seed, acid treated.	Jonna, naphthalene preserved.
Lab. numbers	1580/38–39	1581/38–39
Moisture	3·18	9·14
Ash	3·50	1·44
Crude proteins	18·34	9·24
Ether extractives	17·54	4·63
Carbohydrates (by difference) ..	42·08	73·87
Total ..	100·00	100·00
True proteins	16·57	8·86
Acid value (number of mgs. of KOH per gram of fat) ..	87·74	68·05

But the acid treated cotton seed sample contained free acid sufficient to detract from its usefulness as a cattle food. The smell of naphthalene persisted in the sample of jonna and its presence was also indicated in a qualitative test. It was considered that these two samples could not be used as cattle foods.

(2) A sample of bone manure (Lab. No. 12/1939–1940) was received from the Agricultural Demonstrator, Kodaikanal, Madura district, who reported that this was prepared by the Sacred Hearts Society at Kodaikanal. On analysis this sample had the following composition :—

	PER CENT.
Moisture	9·61
Loss on ignition	11·13
Insoluble mineral matter	5·04
Lime (CaO)	34·85
Phosphoric acid (P_2O_5)	23·11
Nitrogen (N)	1·21

The sample contained phosphoric acid in amounts for an average sample of bone meal but the nitrogen content was low. The sample, to all appearances, looked like bone ash or bone char and the low content of nitrogen would appear to confirm it. On enquiry it was ascertained that the process adopted by the society in the manufacture of this manure was to burn the bones over a wood fire, then pound them in a stone mortar with iron pestles and finally pass the powder through sieves having meshes of about 40 per square inch. This fine powder was again treated with sulphuric acid and after a lapse of 10 days, chemicals like ammonium sulphate, iron sulphate and potassium nitrate, were added in certain proportions to this ash; the whole thing was then mixed and stored.

The pH of this material in aqueous extract was 6·93 and in its favour. The small amount of nitrogen found would appear to have come from the ammonium or nitrogenous salts added in the manufacture. The sample is essentially a phosphatic manure and cannot be called bone manure.

(3) Two samples of press mud were obtained, one from the Indian Sugars and Refineries, Hospet, and the other from the Vuyyur Sugar Factories, Vuyyur, Kistna, for analysis with a view to see how far these would be suitable materials for composting with organic materials. From the analytical data given below it will be observed that these contain high amounts of phosphoric acid and fair amounts of nitrogen. Sugars are almost absent. These may be used also directly for manuring fields but it is better to allow this to decompose for some time and then to utilize it for manurial purposes. Both the samples have analysed similarly.

	Press mud samples.	
	Hospet.	Vuyyur.
	PER CENT.	PER CENT.
Moisture	9·82	9·09
Loss on ignition	61·34	56·10
Soluble mineral matter ..	21·37	23·62
Iron and Alumina (Fe_2O_3 and Al_2O_3)	2·50	2·54
Lime (CaO)	8·56	9·88
Magnesia (MgO)	1·25	1·03
Potash (K_2O)	0·65	0·39
Phosphoric acid (P_2O_5) ..	5·26	5·23
Nitrogen (N)	1·63	1·62
Sugars	Traces.	Traces.

(4) A sample of the residue (Lab. No. 1094/39–40) left over after the distillation of orange peels was analysed for the Superintendent, Kerala Soap Institute, Calicut, who desired to know if this could be of use as a cattle or poultry feed. The material had the following feeding value :—

	PER CENT.
Moisture	10·65
Ash	10·40
Crude proteins	7·62
Ether extractives	1·03
Crude fibre	13·94
Carbohydrates (by difference)	56·36
	100·00
True proteins	7·05
Nitrogen (N)	1·22
Potash (K_2O)	1·25
Phosphoric acid (P_2O_5)	0·22
Lime (CaO)	1·22

The sample was a dirty looking powder with a disagreeable odour. It was considered that it would not be worth the while to use this for feeding either cattle or poultry. However, considering the amounts of minerals and nitrogen it contained, this could be better utilized for manurial purposes and that preferably by composting it.

(5) The Assistant Director of Agriculture, Coimbatore, sent three samples of wattle bark obtained from three different villages in the Ootacamund taluk, Nilgiris district, which were examined for their total astringent matter in terms of tannic acid and were found to contain fair amounts of tannin as the following data would indicate :—

Particulars.	Wattle bark samples. Anikkorai village.	Nanjanad village.	Thimmanathur village.
Lab. Nos./39–40 ..	1408	1409	1410
	PER CENT.	PER CENT.	PER CENT.
Moisture	5·12	5·82	7·78
Total astringents ..	30·33	37·15	36·67
Tannins (As estimated by precipitation in 2 per cent gelatine solution)	25·85	32·67	32·01
Non-tannins	4·48	4·48	4·66

The above values are all expressed in terms of tannic acid. All the three samples contain good amounts of tannin and those from the Nanjanad and Thimmanathur villages are

better than the other one. Wattle bark is now mainly imported from South Africa and the indigenous material may well take the place of the imported material.

(6) The Agricultural Demonstrator, Shiyali, sent a sample of paddy husk carbon (Lab. No. 1095/39–40) for having its manurial value tested. Round about the taluk, this carbon that is obtainable from the paddy milling factories, would appear to be largely applied to wet lands for paddy, for its supposed contents of phosphoric acid and potash. The analytical results given below indicate the presence of fair amounts of Phosphoric acid. The insoluble mineral matter is very high and potash content is low. Being a carbon sample, nitrogen is naturally very low. As a manure it cannot have much value.

	PER CENT.
Moisture	4·42
Insoluble mineral matter	73·19
Nitrogen (N)	0·22
Potash (K_2O)	0·73
Phosphoric acid (P_2O_5)	1·33
pH	7·7

The aqueous extract was tested for its pH which was 7·7.

But the feeling among the ryots using this is that they have found the application of this at 12 cart-loads per acre increases the yield by about 300 lb. per acre and that it corrects alkalinity in course of time. This can be tested only by conducting systematic experimentation.

(7) A sample of Agathi leaves—*Sesbania grandiflora*—was analysed for its feeding value. This contained a moisture content of 79 per cent and on dry basis its composition was—

	PER CENT.
Ash	11·62
Crude proteins	33·48
Ether extractives	2·57
Crude fibre	5·67
Carbohydrates (by diffce.)	46·76
	100·09
Lime (CaO)	2·33
Phosphoric acid (P_2O_5)	0·34

The leaves have a good feeding value, but like all leguminous fodders should be used with certain amount of caution; large quantities might produce tympanitis when fed.

(8) A sample of distillery waste (Lab. No. 11/39–40) was analysed for the Superintendent, Agricultural Research Station, Anakapalle, with the following results :—

	PER CENT.
Moisture	12·00
Insoluble mineral matter	9·77
Nitrogen (N)	2·45
Potash (K_2O)	4·85
Phosphoric acid (P_2O_5)	0·41

The sample was obtained from the Sugar Factory at Thummapala. This contained fair amounts of nitrogen and potash but was rather poor in its content of Phosphoric acid. The material is eminently suited for compost making.

(9) A sample of stone (Lab. No. 718/39–40) was analysed for its lime content for one Sri T. P. Veluswami Pillai, Cinder Contractor, Mettur Road, Erode. This analysed as follows :—

	PER CENT.
Moisture	0·04
Loss on ignition	0·26
Insoluble mineral matter	0·34
Soluble (by difference)	99·36
	100·00
Lime as CaO	53·94
Carbonates as CO_2	43·38
Sulphates as SO_3	0·10
Magnesia as MgO	1·50
Lime as calcium carbonate $CaCO_3$	96·32
Magnesia as magnesium carbonate $MgCO_3$ ..	1·92

On analysis, it was found to be a good sample of Calcite.

(10) A large number of samples of soils, about 100 in number, was received in the year under review from several Executive Engineers, taken from fields, etc., adjacent to tanks for being examined as to their fitness for bund formation. The analysis was done with reference to their mechanical composition and soluble salts contents. If these soils contain high soluble salts with a pH on the alkaline side, there is the likelihood ultimately of the water of the tank being affected thereby. Special mention may be made of the work undertaken by my section for the Executive Engineer in charge of the Poondi Reservoir Scheme in this direction. About 60 samples were received from him drawn from a large number of fields selected in relation to the dam site. Most of these samples were not suitable as they were laden with high amounts of soluble salts and had a pH content

over 8·5. Finally, in consultation with the Executive Engineer, about 15 soils drawn from fields in the Poondi and Rangapuram villages were selected and submitted to detailed examination and these were found suitable for bund formation.

II. Teaching.

Degree course of Madras University.—The following table gives details of Lecture classes, Practical classes and Special lecture classes conducted for the students of the B.Sc. (Ag.) degree course during the academic year 1939–40 :—

Class.	Lecture classes.	Practical classes.
I	60	60
II	70	30
III	139	88
Total ..	269	178

The lecture classes were each of one hour duration while the 178 practical classes had a duration of 338 hours.

In addition four special lectures were delivered by members of the Research Staff on specific problems on which they were engaged to give the degree students of the final year class a summary of work in progress in the research side of the section.

Short courses of the Agricultural College—(a) Malt making.—A course of lectures and practical demonstrations in the making of malt from indigenous cereals was attended by eleven students in the month of September 1939, for a period of a fortnight. Eight lectures were delivered and a practical course given to enable the students to study the practical aspects of the subject.

(*b*) *Jaggery making.*—This short course was attended by thirteen students for a fortnight in February 1940. Lectures and demonstrations of making of jaggery from cane juice and palm juice were conducted.

III. Research.

Reclamation of alkaline lands in the High Level Channel area, Kulittalai taluk.—The investigation was continued during the year and one crop of green manure (Dhaincha) and one crop of paddy raised. Soil samples were taken after the harvest of the paddy crop in February 1940. The Dhaincha crop was a good one in the sulphur and gypsum treated plots. Table below gives the yields in

the plots for the 1939–40 crop and also for the previous crop for comparison :—

Green manure (Dhaincha).

Treatment.	First crop harvested 4th October 1938. Yield (green) in lb. per acre.	Second crop harvested 20th August 1939. Yield (green) in lb. per acre.
1 Sulphur at one ton per acre.	4,827	15,893
2 Do. at two tons ,,	4,507	16,440
3 Gypsum at ten tons per acre.	5,507	14,480
4 Do. do. ,,	3,613	14,733
5 Sulphur at two tons ,,	4,493	17,107
6 Do. at one ton ,,	1,453	17,240
7 Control unwashed ..	Nil.	Nil.
8 Do. washed ..	Nil.	6,533
9 Do. do. ..	Nil.	5,840
10 Do. unwashed ..	Nil.	Nil.

The paddy crop was harvested at the end of January 1940 and table below gives details of yields of grain and straw for the 1939–40 crop and also for the 1938–39 crop for purposes of comparison.

Paddy (Sadai Samba).

Plot.	Treatment.	1st crop harvested 5–2–1939. Yield (sun dried) in lb. per acre.		2nd crop harvested 27–8–1940. Yield (sun dried) in lb. per acre.	
		Grain.	Straw.	Grain.	Straw.
1	Sulphur at one ton per acre	727	1,333	2,600	4,147
2	Sulphur at two tons per acre	900	1,400	2,520	3,987
3	Gypsum at ten tons per acre.	1,260	1,640	2,987	4,333
4	Gypsum at ten tons per acre	1,180	1,440	3,053	3,907
5	Sulphur at two tons per acre	1,193	1,453	2,920	3,987
6	Sulphur at one ton per acre	Nil.	Nil.	2,053	2,893
7	Control unwashed ..	Nil.	Nil.	Nil.	Nil.
8	Do. washed ..	Nil.	Nil.	1,573	2,573
9	Do. do. ..	Nil.	Nil.	120	467
10	Do. unwashed ..	Nil.	Nil.	Nil.	Nil.

It will be seen that both the green manure and paddy crops were good ones, the former recording 19,000 lb. green matter per acre in the sulphur treated and 14,700 lb. in the gypsum plots, while no crop grew on the control unwashed plots. The washed control plots gave a fair yield. When compared to the last year's results, the improvement in yield from the treated plots is striking.

The yields of paddy follow the same trend. The yields from the treated plots were of the order of 2,000–3,000 lb. grain per acre as compared to about 1,000 lb. last year. The washed control plots gave a fair yield also while the unwashed control plots grew no crop at all.

The soils and sub-soils after the paddy harvest were sampled and subject to analysis for total soluble salts, carbonates and bicarbonates, exchangeable bases (soda and potash) and pH value. Table below gives details of analysis for the soils (1—12″) and sub-soils (12—24″) :—

Depth.	Plot number treatment.	Total solids. PER CENT.	Carbonate. CO_3. PER CENT.	Bicarbonate. HCO_3. PER CENT.	Exchangeable Soda & Potash. M. EG.	pH.
1–12″	1. Sulphur 1 ton per acre ..	·068	·0315	·059	1·7	8·90
	2. Sulphur "2 tons" per acre ..	·106	·009	·082	3·1	9·45
	3. Gypsum 10 tons per acre ..	·132	·015	·107	5·8	9·62
	4. ,, ..	·058	Traces.	·055	1·5	8·77
	5. Sulphur 2 tons per acre ..	·117	·0075	·107	5·5	9·60
	6. Sulphur 1 ton per acre ..	·152	·017	·107	5·3	9·80
	7. Control unwashed.	·170	·020	·122	6·3	9·88
	8. Control washed ..	·129	·024	·110	6·1	9·85
	9. ,, ..	·198	·038	·116	10·6	9·68
	10. Control unwashed.	·208	·036	·128	10·5	9·87
12–24″	1. Sulphur 1 ton per acre ..	·127	·024	·081	5·0	9·78
	2. Sulphur 2 tons per acre ..	·232	·066	·098	14·8	9·98
	3. Gypsum 10 tons per acre ..	·225	·057	·101	14·4	9·74
	4. ,,	·135	·027	·075	5·3	9·74
	5 Sulphur 2 tons per acre ..	·235	·069	·091	14·5	9·95
	6. Sulphur 1 ton per acre ..	·246	·074	·090	12·9	10·12
	7. Control unwashed.	·229	·068	·081	14·9	10·17
	8. Control washed ..	·265	·087	·082	14·3	10·18
	9. Control washed ..	·271	·084	·091	14·0	10·07
	10. Control unwashed.	·305	·091	·075	12·9	10.18

It will be seen that the analysis for the surface soils shows a favourable condition of the total solid content, carbonate and bicarbonate content and exchangeable bases and pH value in the six treated plots, while the control unwashed plots are just about the same as they were when the work started. The sub-soil did not show any marked improvement, but it is to be expected that

continued cropping and drainage will improve these sub-soils in course of time. The surface soils of the treated plots may be said to be normal for purposes of crop growth, as also evidenced from crop yields.

It may be stated that the reclamation of the soils, on which nothing grew, has been accomplished in two-and-a-half years time, the first treatment being done in October 1937 with sulphur and in January 1938 with gypsum. There was little difference between the plots treated with sulphur and gypsum. The cost of sulphur is now prohibitive but gypsum is locally available in the adjoining taluk of Perambalur in abundance and if made available at a reasonable price, the reclamation of the soil of the Kulittalai taluk can be accomplished at a rate of about Rs. 100 per acre (if gypsum is available at Rs. 10 per ton).

Based on these results, a scheme was submitted in May 1940 for the starting of demonstration plots in the taluk. An Assistant was deputed to personally inspect the area and sites were selected at three villages (i.e.), Pillaipalayam, Vaiganallur and Nangavaram which are as alkaline and unfit for cultivation as the area at Mettumarudur where the present investigation was carried out. It is proposed to treat the soils with gypsum and provide for drainage as was done at Mettumarudur, in replicated system of plots at each of the three selected villages.

Reclamation of soils, Field No. 77, Central Farm.—A second crop of Chitrai Cholam was grown on this plot since treatment in 1938–39, the first crop of Chitrai cholam being grown in 1939. The crop this year was fair owing to favourable season. The soils have been sampled after harvest of crop and analysis is in progress.

Determination of exchangeable bases in alkaline soils.—The method of determining exchangeable bases in alkaline soils has always presented many difficulties, added to by the presence of calcium carbonate and water soluble salts present, which have to be determined and accounted for. There is therefore a considerable difference of opinion as to the accuracy of the standard methods usually used for the determination of base exchange in such soils.

During the investigation on the alkaline soils of the Kulittalai taluk (reported on above) other methods were investigated and it was found that Puri's method (Soil Science 1935, Volume 40, pages 159 and 249) was about the most suitable. This method uses ammonium carbonate as the leaching solution for alkaline soils. The method is very simple and since sulphates and chlorides do not interfere, no allowance need be made for them, the final operation being a simple titration. The result of estimations of exchangeable Na + K in a number of alkaline soils gave concordant results in close agreement with those obtained by the usual methods which involve long tedious procedure. The values for exchangeable Magnesium in such soils were however not satisfactory with Puri's method, for which it is not suitable.

Studies on the black soils of Madras Deccan—(a) Profile studies. —The study of the Geo-chemistry and origin of the black soils of Madras-Deccan was continued. The study of the soils of typical profiles overlying areas of rocks of three main types met with in the area (i.e.), (i) Hornblendic granites and Gneiss, (ii) Micaceous granite and red granites and (iii) Hornblende schists (Dharwar age) was carried out. The first and third groups of rocks give rise to black soils while the second group gives rise to red soils. Nine profiles, six being black soil profiles and three red, from selected areas overlying these three groups of rocks were subject to a detailed chemical analysis. The black soils were found to be sharply differentiated from the red soils by the SiO^2/R^2O^3 ratio of the clay complex, the values for the black soils being 3 and above and for the red 2 and below. The black soils had a high content of CaO, MgO and Na^2O, while the red soils had distinctly lower values for these three minerals. These characteristics persisted at all depths of the profile. The black soil profiles were also homogeneous with no sign of unconformity at different depths, thus ruling out the possibility of their being transported soils.

(*b*) *Analysis of rocks underlying the various types of rocks.*— The study was extended to one of the rocks underlying the black and red soils to arrive at an understanding of the reasons for the differences in the two types of soils. It has been seen that the black and red soils are formed from different types of rocks and hence vary so sharply in their chemical and physical properties. The soils were also seen to be formed *in situ* for the greater part with no evidence of being transported from any great distance.

With a view to collect representative samples of rocks of the area, for analysis and correlation of the results of analysis with those of the two types of soils, traverses were conducted in and around Bellary, from Bellary to Siruguppa and from Bellary to Adoni. Rock samples were collected wherever it was found outcropping. A large number of rock samples were collected during the traverses and twelve typical rock samples subject to analysis. Results are given in table below :—

Chemical composition of collections of rocks.

Heads of analysis.	Traps.				
	Chlorite Schist. Hagari.	Hornblende Trap. Bevinhalli.	Trap. Chellakurki.	Hornblende Trap (vein) Adoni.	Trap Adoni.
Silica	82·24	50·48	50·28	52·54	52·69
Alumina	9·36	20·13	18·44	24·35	23·04
Iron oxide	2·95	9·60	14·24	6·98	8·05
Sesquioxide	12·31	29·73	32·68	31·33	31·09
Calcium (CaO) ..	0·36	10·98	9·64	7·70	9·42
Magnesium (MgO) ..	0·93	4·21	6·01	5·81	5·21
Potassium (K_2O) ..	..	0·14	0·17	0·78	1·08
Sodium (Na_2O) ..	..	2·23	2·44	3·56	2·74
SiO_2/R_2O_3)	12·44	3·26	3·10	3·09	3·17
Specific gravity ..	2·552	2·88	2·82	..	..
Moisture .. .. Loss on ignition }	0·31	0·14	..	..	0·07

Heads of analysis.	Red granites.			White granites.			Mica granite.
	Adoni.	Bhattara-halli.	Bevin-halli.	Ken-chengud.	Alur hill.	San-gankallu.	Hale-kota.
Silica	71·37	75·28	73·58	73·84	73·36	71·50	72·15
Alumina .. .	14·54	11·95	15·10	13·76	14·12	13·79	14·31
Iron oxide	3·49	3·04	1.28	0·88	1·92	4·48	3·60
Sesquioxide	18·03	14·99	16·38	14·64	16·04	18·27	17·91
Calcium (CaO) ..	1·54	0·35	0·89	1·40	1·40	2·55	1·65
Magnesium (MgO) ..	0·42	0·40	0·43	0·46	0·52	1·29	0·54
Potasium (K_2O) ..	3·83	4·47	..	3·78	4.34	1·19	4·41
Sodium (Na_2O) ..	3·54	3·79	..	4·43	3·69	4·90	4·21
SiO_2/R_2O_3	7·24	9·20	8·01	8·98	8·36	7·30	7·72
Specific gravity ..	2·48	2·45	..	..	..	..	..
Moisture .. .. } Loss on ignition. }	0·33	..	..	0·64	0·48	0·39	..

It is seen that the Traps (related to the Deccan traps of Bombay) but only occurring as small formations at Bevinahalli, Chellakurki and Adoni, had a high content of lime, magnesia and soda and a low content of potash, the Red granites of Adoni, Battarahalli and Bevinahalli had a low content of lime and high content of potash and also of soda. The same was the case with the white granites and Micaceous granites of Kenchengudum, Alur, Sangankallu and Halekota.

No conclusions can be drawn at this stage of the investigation beyond stating that the mineral Hornblende, if present in the country rock, contributes to a high content of calcium, magnesium and soda and low potash content, and that granites and gneisses containing Hornblende are of frequent occurrence in the tract. Further work is in progress on the problem.

(*c*) *Organic matter content as influenced by adding green manure.*—This work was started during the year at the Agricultural Research Station, Siruguppa, in Block VII, Field 1. Plots of 10 cents each were laid out with two treatments, no manure and green manure, cropped and fallow, irrigated and unirrigated in each series. Four series of soil samples were drawn, the first before application of green manure, the second on date of sowing, the third at the middle stage of the crop (cholam) and the fourth after harvest.

The results of analysis show no differences between the treatments, either of addition of green manure at 4,000 lb. per acre or of irrigation or cropping.

The experiment is being repeated with an application of 8,000 lb. green manure per acre.

(*d*) Microbiology of the black soils (see under item Microbiology below).

(*e*) *Studies on the delta soils.*—Soil surveys of the deltas of the Kistna and Godavari were carried out by this section in the years 1918–1922. The soil survey was one of the surface soils, with a view to assess their fertility status with reference to the three manurial nutrients Nitrogen, Phosphoric acid and Potash. The reports of those soil surveys gave information as to the areas which

had a sufficiency or deficiency of the manurial ingredients. The soil surveys yielded valuable information on the requirements of the surface soils, but no mention was made of the types of soils and their profile characters. With the advance in soil science, it is now recognized that the surface soil is only one part of the soil profile, and that a study of the lower layers of the profile have a great influence on the fertility status of the surface layers.

A study was therefore started on the profiles of soils of the deltas of the Kistna and Godavari rivers with a view to study their composition and genetics.

A preliminary tour by an assistant of this section covered the two deltas. Samples of soil of the profile were taken at Bezwada, Dosapadu, Bhimavaram, Nidadavolu, Ramachandrapuram, Amalapuram and Pithapuram. The first two samples represent the Kistna delta, that taken at Bhimavaram, the junction of the two deltas, those at Nidadavolu, Ramachandrapuram and Amalapurm, the main Godavari delta and that at Pithapuram the tail end of the Godavari delta, on the border of the Vizagapatam district.

The profile features as recorded during the preliminary survey were interesting. The Kistna delta soils were deep soils extending well below 6 inches and consisted of dark coloured soils with a very low water table. Those of Bhimavaram were with greyish soil down to $2\frac{1}{2}$ feet deep and below that fine sand with patches of black and kankar and with a water table at about 5–6 feet deep. The profiles in the Godavari delta were with black soil at the surface but below that layers of sand and silt with a high water table—5–6 feet down. The analysis of the soil samples for pH value and total soluble salt content showed that in general soils of the Kistna delta had a pH value of 8–9 while those of the Godavari delta a value of 7–8·5. The soluble salt content was higher in the soils of the Kistna delta with a tendency to accumulation at lower horizons while in the Godavari delta soils had a considerably lower salt content and no tendency to accumulation at lower horizons except at Nidadavolu and Bhimavaram. It would seem that the types of soils of the two deltas are different owing probably to their being derived from different catchments. Further work is in progress.

Compost making.—The method of making composts worked out at the Indian Science Institute, Bangalore, and known as the " Bangalore " method was compared with the method used at Coimbatore and known as the " Coimbatore " method. There is not much difference in the technique of the two methods, only the Bangalore method is essentially anerobic and the Coimbatore method, partly aerobic; the former is claimed to be easier of application and involves less labour during its preparation. The investigation was carried out at Coimbatore by my section and also at some of the research stations, the material used being estate rubbish.

The Coimbatore method gives a smaller quantity of compost of higher manurial value than the Bangalore method which gave a higher net yield but with a lower manurial value. The Coimbatore method gives higher phosphoric acid, potash and nitrogen contents than the Bangalore method. Table below gives the quantities of manurial ingredients calculated on one ton of compost prepared :—

	Coimbatore method.	Bangalore method.	Gain in favour of Coimbatore method.
	LB.	LB.	LB.
Nitrogen (N)	19·0	16·0	3·0
Potash (K_2O)	17·5	15·2	2·3
Phosphoric acid (P_2O_5) ..	15·0	9·0	6·0
Humus	14·6	9·9	4·7

Field experiments—(i) Old permanent manurial experiments.—(*a*) The old permanent manurial experiments which were lying cultivated fallow since 1937 owing to lack of irrigation facilities which have now been again provided, were cropped with Panivaragu (crop No. 70) and harvested in February 1940. The yields were fair; no manure plot gave 355 lb. of grain and 567 lb. of straw per acre. The plots receiving the various fertilizers either alone or in combination gave an yield of 500 to 520 lb. of grain and 900 to 1,000 lb. of straw per acre on an average. The cattle manure plot alone gave a poor yield. There was a rank growth of weeds in this plot which might have partly contributed to the low yield. The details of the yields and the experiments are given below :—

Results of yield of Panivaragu crop No. 70 in old permanent manurials, 1939–40.

Sown on 28th November 1939. Harvested on 15th February 1940.

Plot number.	Treatment.	Per acre. Grain.	Straw.
		LB.	LB.
1	No manure	355	567
2	Nitrogen	398	581
3	N + K	459	719
4	N + P	520	902
5	N + K + P	520	994
6	K + P	550	978
7	K	582	918
8	P	520	902
9	Cattle manure ..	273	652
10	Cattle manure residual ..	348	577

(ii) *New permanent manurial experiments.*—In the New Permanent Manurial series conducted in field No. 45, Central Farm, two crops were harvested in the year, namely, crop No. 24

(Ragi) in September 1939 and crop No. 25 (Panivaragu) in March 1940. The yields of grain and straw obtained from both the series for both the crops are tabulated below :—

Crop No. 24, Ragi.
Transplanted, 19th to 21st June 1939.
Harvested on 25th September 1939.

Plot Number.	Treatment.	Per acre.			
		Eastern series.		Western series.	
		Grain.	Straw.	Grain.	Straw.
		LB.	LB.	LB.	LB.
1	No manure	800	2,925	475	2,325
2	Nitrogen	675	2,425	625	3,450
3	N + Potash	775	2,575	625	3,100
4	N + Phosphoric acid	1,225	5,175	1,000	5,150
5	N + K + P	1,025	5,125	975	5,225
6	K + P	850	4,100	975	5,275
7	K	550	2,300	775	3,850
8	P	1,150	4,800	1,050	4,600
9	Cattle manure	1,000	5,500	1,150	5,800
10	Cattle manure residual	550	2,550	1,075	4,575

Crop No. 25, Panivaragu.
Sown on 9th December 1939.
Harvested on 9th March 1940.

Plot Number.	Treatment.	Per acre.			
		Eastern series.		Western series.	
		Grain.	Straw.	Grain.	Straw.
		LB.	LB.	LB.	LB.
1	No manure	475	725	575	575
2	Nitrogen	375	350	600	625
3	N + Potash	400	500	500	625
4	N + Phosphoric acid	350	625	550	775
5	N + K + P	375	725	500	800
6	K + P	400	600	550	800
7	K	450	525	500	550
8	P	400	600	450	600
9	Cattle manure	550	1,100	600	775
10	Cattle manure residual	375	400	475	600

In respect of crop No. 24, the yield of grain has been low in general, the plots which received phosphatic manure application, either alone or in combination have given increased yields. In respect of crop No. 25 germination was poor. The yields in the eastern series were slightly less than those in the western series which received, in addition, a basal dressing of cattle manure at 5 tons per acre. No manure plot in the eastern series yielded 475 lb. of grain and 725 lb. of straw per acre while the same plot in the western series gave 575 lb. of grain and 575 lb. of straw. In these experiments, the cattle manure plot gave the maximum yield.

(iii) *Effect of manuring of seed bed on paddy.*—The scheme of work related to these experiments has been explained in detail in the previous reports. These were started two years ago in 'B' block, wet lands, Central Farm, with the object of assessing, if possible, how far a correct and liberal manuring of the paddy nurseries would tend to be economic. Last year's results have been significant. This season, another crop, with the same variety of paddy, Co. 1, was raised as a second year trial. The yields obtained are presented below in a tabular statement. Indications are that the seedlings from a heavily manured seed bed have shown maximum performance when transplanted irrespective of the variation in the application of fertilizer to the transplant fields. These experiments will be continued one more season when results can be reviewed in detail.

Seed bed manurial trials—B Block—Wet lands, Central Farm.

Transplanted—8th and 9th September 1939.
Harvested—29th December 1939.

Variety CO. 1.
Second year trials.

Yield in lb. per acre.

No manure plots.

Poor seedlings. A.			Normal seedlings. B.			Heavily manured seedlings. C.		
Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.
3	3,200	3,760	6	3,147	3,547	8	2,880	3,493
10	2,720	3,521	18	2,320	2,613	16	2,347	2,960
26	2,214	2,427	25	2,347	2,907	20	2,720	3,414
29	2,080	2,533	31	2,294	2,587	32	2,241	2,533
Average ..	2,554	3,060		2,527	2,914		2,547	3,100

Half manure plots.

Poor seedlings. D.			Normal seedlings. E.		
Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.
5	3,707	4,187	9	2,986	3,574
11	2,561	3,067	15	2,613	3,174
22	2,960	3,334	21	3,521	3,654
33	2,347	2,613	35	2,480	3,174
	2,894	3,300		2,900	3,394

Half manure plots—*cont.*

Heavily manured seedlings. F.		
Plot.	Grain. LB.	Straw. LB.
2	3,521	3,868
13	2,880	3,094
27	2,294	2,880
28	2,907	2,694
Average ..	2,901	3,134

Normal manured plots.

Poor seedlings. G.			Normal seedlings. H.			Heavily manured seedlings. K.		
Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.
4	4,027	4,267	7	3,466	4,027	1	4,133	4,347
17	2,827	2,521	12	3,147	3,707	14	3,067	3,414
19	3,868	4,533	23	3,387	3,626	24	3,547	3,868
34	2,960	2,960	36	2,453	2,747	30	2,400	2,667
	3,421	3,720		3,113	3,527		3,287	3,574

The experiment satisfies " Z " test and the general effect of block as well as treatment is significant.

Nursery area.	Per acre. Grain. LB.	Straw. LB.
Heavily manured	3,143	3,893
Normally manured	3,143	3,645
Poorly manured	2,303	3,546

(iv) *Manuring and spacing experiments with paddy.*—Another experiment has been started in the wet lands, Central Farm, this season, embodying a combined spacing and manurial treatments. Thirty-six plots were freshly laid in the A and B blocks of the wet lands, Central Farm, to give nine treatments and four replications. The nine plots in each block were randomized; the size of each plot was 3·6 cents. The variety of paddy grown was G.E.B. No. 24. The object of the experiment was to see how a wider spacing adopted in transplanting followed by application of larger amounts of fertilizer would result in a favourable yield or be economic.

A basal dressing of 3,000 lb. of green manure was given to all the 36 plots. Ammonium sulphate was the fertilizer used for manuring in these experiments and this was applied at three levels. Thirty pounds of N, 50 lb. of N and 70 lb. of N per acre at three stages of the plants growth in equal amounts, namely :—

First application, three weeks after transplanting, second application, five weeks after transplanting, and third application, seven weeks after transplanting. The spacings adopted in transplanting were (i) 6 inches, (ii) 12 inches and (iii) 18 inches.

It was seen that there was a good deal of saving both in the amount of seedling and in the time taken for transplanting when the wider spacing 12 inches or 18 inches were adopted.

It was also noticed that the tillering was generally good in the wider spaced plots. The yields of paddy this season are presented in the tabular statement below and were found to be statistically significant for treatment and satisfied the "Z" test. These experiments will be continued for two more seasons, when the results will be reviewed; comments are reserved in the meantime. The treatments are as follows :—

A. Thirty pounds of Nitrogen per acre and 6 inches spacing.
B. Thirty pounds of Nitrogen per acre and 12 inches of spacing.
C. Thirty pounds of Nitrogen per acre and 18 inches spacing.
D. Fifty pounds of Nitrogen per acre and 6 inches spacing.
E. Fifty pounds of Nitrogen per acre and 12 inches spacing.
F. Fifty pounds of Nitrogen per acre and 18 inches spacing.
G. Seventy pounds of Nitrogen per acre and 6 inches spacing.
H. Seventy pounds of Nitrogen per acre and 12 inches spacing.
K. Seventy pounds of Nitrogen per acre and 18 inches spacing.

Combined manuring and spacing experiments—A and B Blocks—Wet lands, Central Farm.

Transplanted—31st August 1939.
Harvested—18th December 1939.

Variety GEB. 24.

Yield in lb. per acre.

70 lb. Nitrogen.									50 lb. Nitrogen.					
18 inches. K			12 inches. H			6 inches. G			18 inches. F			12 inches. E		
Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.
1	2,500	5,357	5	2,463	4,428	6	2,679	6,036	8	1,964	4,107	4	2,357	4,464
12	2,000	4,392	11	2,000	4,143	14	2,786	4,820	16	2,607	4,678	25	2,250	3,642
21	2,964	4,714	24	2,500	3,714	19	2,714	5,142	27	2,143	3,607	28	1,822	3,321
35	1,857	4,178	34	1,857	3,964	30	2,679	4,107	33	2,071	4,535	18	2,821	4,357
Average ..	2,330	4,660		2,205	3,062		2,715	5,026		2,196	4,232		2,313	3,946

50 lb. Nitrogen—*cont.*			30 lb. Nitrogen.								
6 inches. D			18 inches. C			12 inches. B			6 inches. A		
Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.	Plot.	Grain. LB.	Straw. LB.
2	2,679	5,071	9	1,678	3,143	3	2,286	3,678	7	2,357	3,714
13	2,463	4,066	10	1,857	3,249	17	2,286	3,714	15	2,964	5,535
20	3,249	5,249	22	2,393	3,785	23	2,967	3,750	26	2,964	4,500
29	2,393	3,607	36	1,536	3,357	32	1,607	2,429	31	2,714	3,071
Average ..	2,696	4,473		1,866	3,384		2,287	3,393		2,750	4,205

The experiment satisfies "Z" test and the general effect of treatment is significant.

Studies on quality in Virginia tobacco.—Preliminary studies were started on the problem of quality in virginia tobacco in the Guntur as a result of a memorandum presented by the Indian Tobacco Association, Guntur, in April 1939, in which the need for research into the quality of tobacco and its manuring for better yields were called for.

An investigation was started to study the factors that control quality in Virginia tobacco. The area was visited and enquiries made regarding the crop, rotations, manuring and method of curing and subsequently samples of tobacco leaf of the various qualities and the soils on which they were grown were received and subjected to study. The leaves of different qualities varying from good to poor were analysed for total ash, ash constituent, nicotine and nitrogen content and conductivity. It was found that the good quality leaf had a low soluble salt and nicotine content and the poor grade leaf, a high soluble salt content and high nicotine content. The soils on which the good grade tobacco was grown was found to have a low salt content also. Quality in Virginia leaf would therefore seem to be associated with low salt content in the leaf and with a soil of similarly low soluble salt content. From a consideration of the factors involved in the production of tobacco leaf of good quality (i.e.), the place of tobacco in the rotation and effect of fertility of soil, it would seem that tobacco produces the best quality when it follows cholam and in not too rich soils. The findings of the chemical study fit in with these facts that quality in tobacco is associated with a diminished metabolism of the plant; when less vigour means a lower uptake of soluble salt and lower quantity of nicotine produced.

Studies in quality in coffee.—This study was started at the instance of the Marketing Adviser to the Government of India, to distinguish between high grade coffee powder made from *C. Arabica* and low grade powder made from *C. Robusta* for the purpose of grading coffee powders marketed. A preliminary study of representative samples of coffee for chemical characters showed that *C. Arabica* had a high oil content (Ether Extract) as compared to *C. Robusta* (both in the powdered roasted form). The other difference being flavour which is not capable of measurement.

Animal Nutrition.

New feeding standards for working bullocks.—The suggested system of rationing of working bullocks based on work done in this section was tried out at all the Agricultural Research Stations of this department. Reports on the working of the standards were received during the year from 23 stations and in most of the reports the new standard rations were said to be suitable for working animals and did not result in any untoward effect on the animals. In some of the stations that reported the rations as not suitable, the reason was that the prescribed ration for the given

level of work was not fed. A consolidated report on the results of feeding work animals in the stations was submitted in May 1940. The conclusions arrived at as a result of the reports was that in general, the new standard rations graded for maintenance, moderate, heavy and very heavy work on the slab system were generally satisfactory provided the ration was fed at the proper level for each level of work and changed when work increased or decreased to the next successive slab. There was however an uncertainty as regards the classification of work under the various grades moderate to very heavy and hence an uncertainty as to the level of rations to be fed. It was therefore proposed that to be on the safe side the three slabs for work to be reduced to two (i.e.), " Heavy work " and " Very heavy work " in addition to the basic slab for " Maintenance." Again it seemed that for the heavy Ongole animals a flat rate increase of ration be recommended of $\frac{1}{2}$ lb. concentrate extra for all the three slabs.

As has been stated in my detailed report last year 1938–39 (page 23 of printed report), the new standard rations were suggested as it was felt that (i) there was no uniformity or system in the feeding of working bullocks in the various Agricultural Research Stations, (ii) the rations being fed were generally on the high side supplying in some cases very much more nutrients than called for, and (iii) the usual rations fed were not differentiated for different levels of work. In brief the lack of system in feeding bullocks was not economic; the flat rate of feeding being universal whether the animals had work or not.

The new standards are meant to do away with the defects noted above. A calculation of the cost of the usual rations fed formerly for all levels of work amounts to Rs. 7–4–5 per mensem per head, by adopting the new standards the cost for very heavy work works out to Rs. 4–7–7 and for maintenance Rs. 3–14–0. In the case of very heavy work the saving is of the order of about 40 per cent and for maintenance of about 55 per cent.

Feeding of bullocks with synthetic nitrogen.—A preliminary attempt was made to study the effect of feeding synthetic nitrogenous compounds to bullocks in place of the natural proteins. This work was designed to see whether synthetic nitrogen can replace protein nitrogen. The experiment was started in March 1939 and completed in October 1939.

The experiment consisted in the feeding of urea (synthetic compound) as a partial substitute for protein nitrogen in the diet of bullocks. Urea was fed at two levels (i.e.), 25 per cent and 50 per cent of the total nitrogen requirement the rest being made up of protein nitrogen from groundnut cake. The experimental animals did not lose weight appreciably nor was the nitrogen balance negative. In two groups of animals, one being fed all the nitrogen as

protein and the other with 25 per cent and 50 per cent as urea the products of metabolism as shown by the catabolites in the urine were of the same type and quantity. Synthetic nitrogen would seem to have been metabolized and used in the same way as natural protein nitrogen. The experiment could not be pursued owing to the cost of obtaining urea : but the preliminary feeding points to the conclusion that during times when natural proteins are not obtainable as is now happening in Europe owing to the war, animals might possibly be maintained at a fairly normal level by the feeding of synthetic nitrogen exemplified by urea.

Dynamometric measurement of intensity of work during mhoting.—In connexion with the studies on the protein requirement of working bullocks during periods of muscular work as reported on last year (detailed report of Government Agricultural Chemist for 1938–39, pages 21–22) when a relation was obtained between the intensity of work and the protein requirement, a measurement was made of the actual intensity in dynamometric units for the work output during an 8-hour working of a pair of bullocks. This work was carried out with the kind co-operation of the Research Engineer. The results of the study were that (i) the quantum of work performed during an 8-hour day by a pair of bullocks was in the neighbourhood of 2×10^6 foot pounds (=2,000,000 foot pounds); (ii) the work performed during each pull of the bucket upwards was a rhythmic pulse increasing during the upward pull of the bucket from the water level, the animals walking down the ramp, reaching a maximum just before the discharge of water from the bucket, and then decreasing rapidly during the pull of the bucket into the well the animals walking backward up the ramp.

Microbiology.—Microbiological population of black soils (vide section studies on black soils above).

This study was started during the year to study the microbiological population of the black soils before and after irrigation. The micro-flora of a soil is directly responsible for much of the fertility of a soil and hence this study is expected to yield results of interest as no data is now available on the subject.

Soil samples from four different places in the Siruguppa Agricultural Research Station were obtained for analysis. The study included the study of total bacterial count and for ammonifiers and nitrifiers. The results of the study showed that in general the soils had a low total bacterial count of about 700,000 per gram of soil. This low count of total bacteria is rather universal for surface soils and resembles the figure for the subsoil of ordinary cultivated soils. Samples of soils from other black soil areas (i.e.), Cotton Station, Coimbatore, and Athipalayam (Coimbatore district) and also from the Old Permanent Manurial plots, Coimbatore, were taken for comparison and the total bacterial numbers estimated statement

below gives the value of total bacterial counts of different types of soils for comparison—

	Total bacterial counts. (Per gram of soil.)
Black soil, Siruguppa (average)	700,000
Black Soil Cotton Station, Coimbatore ...	5,800,000
Black Soil, Athipalayam, Coimbatore .	2,900,000
Garden soil, rich, Coimbatore	5,000,000
Garden soil, poor, Coimbatore	2,000,000

It will be seen that the bacterical count for the black soil from Siruguppa is very low as compared with the cultivated soils and even with the black soils of Athipalayam and the Cotton Station. The counts for the Ammonifiers and Nitrofiers are similarly low for the Siruguppa soils. Further work is in progress.

Fermentation of molasses for power alcohol.—The work on the fermentation of molasses for the production of power alcohol was concluded during the year, with a study of the conditions for the maximum production of alcohol from molasses. It was found that with a 40 per cent molasses mash with mono calcium phosphate added at 0·1 per cent in volume, and urea at 0·2 per cent in volume and adjusted to pH 6 the mash if incubated at 30°C, sterilized with steam and inoculated with 10 per cent inoculum gave a yield of 22 per cent alcohol by weight of 27·5 per cent by volume.

Berseem and Berseem culture.—Berseem was grown in Field No. 59-A in the Central Farm and gave a total of 28,000 lb. of cuttings per care. The nodule culture or berseem was distributed to 17 research stations.

Malting of cholam—Clinical tests with cholam malt food.—The tests in Government, private and Mission hospitals were completed during this year. Reports were received from 27 hospitals where the malt food supplied by this section in vacuum packed tins with instructions as to how to make it up for administration was tried on a large number of patients suffering from a variety of diseases, and invalids and infants. The reports were in general favourable. The results with cases suffering from gastro-intestinal disorders where it was proved suitable if not beneficial is gratifying. In the case of invalids and infants also the food was found to be suitable and improved their condition. It may therefore be stated that with the present method of making malt food from cholam, the product can be used with confidence for gastro-intestinal cases and with invalids and infants.

Bulk malting of cholam and other cereals.—Using the improved technique, the following are the quantities of malt made from cholam varieties and other cereals :—

	LB.
Periyamanjal cholam (including A.S. 29)—	435
Chinnamanjal cholam	70
T_1 cholam	120
Tenkasi cholam	65
A.S. 2095	27
Nandyal 224	25
Chittoor	20
Nandyal 29/68	20
Nandyal T_6	15
J. 75 (Guntur)	10
A.S. 4087	5
A.S. 3960	3
A.S. 6002	3
Total ..	818
Ragi (including 3 lb. of E.C. 1540) ..	140
Paddy	164
Pusa wheat (from Siruguppa)	10
	1,132

Malting of cholam varieties.—Bulk samples of cholam varieties were tested for their suitability for malting. The following varieties were tested :—

Nandyal strains 29/68 grown at Nandyal.
Do. 28/3 do.
Do. T_6 do.
Do. 224 ,, Siruguppa.
Hagari strain T_1 ,, Hagari.
Guntur 75 ,, Siruguppa.
Tenkasi cholam ,, Tenkasi.

All gave good results, the T_1 had the best aroma.

The Millets Specialist sent eight samples A.S. 6202, 4087, 3960, 6002, 4095, 4168, 4607 and 5818 for test of suitability for malting; from preliminary tests A.S. 4087 was found to be the best.

Blending of malts for making foods.—As was stated in my report last year, the blending of malts from the different cereals, to make a malt food of given value for protein content and therefore with different biological values. Table below gives the analysis of four blended foods prepared.

Heads of analysis.	Cholam and rice blended malt.	Cholam and ragi blended malt.	Rice and ragi blended malt.	Cholam malt and milk powder blended.
	PER CENT.	PER CENT.	PER CENT.	PER CENT.
Moisture	8·22	7·21	9·25	6·15
Calculated on moisture free basis.				
Ash	1·55	1·75	1·21	2·97
Crude protein (N × 6·25)	8·26	8·81	5·13	12·69
Ether extract	2·68	1·73	1·26	3·58
Crude fibre	0·06	2·46	0·74	1·51
Carbohydrates (by difference).	87·45	85·25	91·66	79·25
Total ..	100·00	100·00	100·00	100·00

Biochemical study of the oil from cholam.—The oil or fat from cholam has been previously shown to be responsible for the deterioration of stored malt foods, by the oxidation changes it undergoes when air is allowed access to the stored product. The oxidation process results in the breaking down of the fat into its component fatty acids which give rise to rancidity in the malt food. A systematic study of the fat fraction from cholam malt was started during the year with a view to characterise the fat before any studies can be undertaken on how to prevent rancidity settling in. A quantity of fat was obtained by the successive extraction of malted cholams with sulphuric ether and the fat analysed for its chemical characteristics.

The study is in progress with stored cholam malt meal.

Cholam malt making plant.—Machinery for the making of cholam malt on a large scale suitable for the commercial making of cholam malt was designed and constructed by the Industrial Engineer to Government on data furnished by this section. A preliminary run of the plant was conducted in May 1940, some slight modifications were suggested and are being carried out before the units are brought to Coimbatore for a trial.

Cholam malt as a cottage industry in rural areas.—The making of cholam malt was demonstrated during the year in the Chittoor district at several villages by an Assistant deputed from this section. There was an enthusiastic response to the demonstration and reports have been received since, from the Chittoor Taluk Rural Reconstruction Association that the malting of cholam has been taken up at a number of centres and that 300 lb. of cholam and ragi malt had been sold in the town of Chittoor.

Active carbon and jaggery—Active carbon from paddy husk.—Active carbon was prepared from paddy husk in large quantities, about 2,000 lb. being so prepared for the use of Departmental officers for jaggery demonstration, and limited quantities were sold to private parties. The demand for the active carbon was high during the year.

Active carbon from groundnut husks.—Attempts were made at preparing a high grade active carbon from groundnut husks. Various methods used produced a high grade carbon, but the cost of production was considerably higher than that for paddy husk carbon.

Preparation of cube jaggery from low purity cane juices.—In the district of Coimbatore and round about, cube jaggery generally commands a higher price than lump jaggeries and it has been our experience that when the purity of cane juices fall down to about 80°—82°, the preparation of cube jaggery becomes very difficult. In such cases, either lump jaggeries are prepared or very dark cube jaggeries by the addition of a large excess of lime.

Experiments conducted in the laboratory scale with a view to obtaining a better coloured cube jaggery from low purity juices gave satisfactory results with the following method.

Superphosphate to the extent of 0·1 to 0·2 per cent on the juice in weight is added to the cold juice and lime immediately after, to a reaction very slightly acid to litmus. The juice is then boiled, scum removed and lime again added to a reaction just alkaline to litmus. The boiling is continued for a few minutes and the juice allowed to settle down in a separate pan for 15 to 20 minutes. The golden-yellow supernatant juice is syphoned and concentrated in the usual way. The mass sets readily enough to enable the preparation of cube jaggery and the jaggery so obtained is of a satisfactory colour.

With some juices it has been found necessary to place the concentrated thick mass of final syrup over a boiling water bath for about 10 to 15 minutes to make it crystalline before transferring into the proper mould.

It must be mentioned that cube jaggery prepared as above from low purity juices is inferior in keeping quality to that prepared from high purity juices.

Recovery of second sugar from molasses.—Reboiling of molasses yielded only a low percentage of fine-grained sugar of brown colour. The following procedure gave a recovery of about 25 to 30 per cent of good quality sugar on the weight of molasses.

To the concentrated syrup rab kept at 60°C, molasses maintained at 60°C was added little by little in the proportion of one of molasses to two of rab and concentration continued to the proper consistency and centrifuged. Three molasses were tried in this way, two of which were of 70 purity and the other of less than 60 purity. In the case of the latter, it was found necessary to add water to the mixed rab in small quantities at a time during the course of the concentration with a view to correct the high viscosity and to obtain an easily curable rab.

Clarification of oils.—It was found that by heating castor oil of the ordinary bazaar quality with 2–3 per cent of active carbon to about 60–70°C for half an hour and then filtering off the oil, a clear oil resulted which could be used as toilet and medicinal castor oil.

COIMBATORE,
12*th August* 1940.

P. VENKATARAMAYYA,
Government Agricultural Chemist.

ADMINISTRATION REPORT OF THE GOVERNMENT ENTOMOLOGIST FOR THE YEAR 1939–40.

I

I beg to submit the following report of the activities of the Entomological section for the year ending 30th June 1940.

II. Charge.

I continued to be in charge of the section as Entomologist.

III. Enquiries and Noteworthy Pests of the year.

There were 305 enquiries from different parts of the Presidency. Most of these related to insect pests of crops and their control and bee-keeping. Besides these, the Entomological and Mycological staff stationed in the districts also dealt with a number of enquiries, a short account of which is given under item XI " Propaganda and Campaign."

The following are some of the more important crop pests which received attention of the headquarters staff during the year under report :—

(1) *Agathi.*—*Terias hecabe*, L from Coimbatore and the stem weevil (*Alcides bubo*, F) from Nellikuppam.

(2) *Bengalgram.*—*Laphygma exigua*, Hb from Coimbatore.

(3) *Ber.*—The fruit weevil (*Aubeus* sp.) and the Coccid (*Monophlebus* sp.) from Panyam.

(4) *Brinjal.*—The lacewing bug (*Urentius echinus*, D) from Coimbatore and *Epilachna* beetles from Coimbatore and Pollachi.

(5) *Castor.*—The semilooper (*Achæa janata*, L) from Coimbatore and Anchetti and the slug caterpillar (*Parasa lepida*, Cr.) from Coimbatore.

(6) *Cardamom.*—The castor pod and shoot borer (*Dichocrocis punctiferalis*, G) from Nelliampathies and Tinnevelly; the cardamom thrips (*Tæniothrips cardamomi*, Ramk) from Gandamanaickanur; and the weevil (*Prodioctes hæmaticus*, Chev) from Ceylon.

(7) *Cashewnut.*—Grubs of *Placæderus ferrugineus*, Linn boring into stems and barks of cashewnut trees from Nileshwar.

(8) *Chillies.*—Scales (*Pulvinaria psidii*, M) from Cuddalore.

(9) *Citrus.*—Scales (*Pseudococcus* sp.) from Coimbatore and *Mytilaspis beckii*, Newst from Kalpetta; fruit-sucking moths

(*Ophideres* sp.) from Omandur and Kodur; the stem borer (*Batocera* sp.) from Puttur and aphids from Kodur.

(10) *Cinchona.*—*Deilephila* sp. from Valparai.

(11) *Coconut.*—The black headed caterpillar (*Nephantis serinopa*, M) from Bhavani, Nellore, Bezwada, Amalapuram and Coimbatore; the rhinoceros beetle (*Oryctes rhinoceros*, L) from Ceylon; the hairy caterpillar (*Euproctis* sp.) attacking coconut buttons from Kasaragod; the scale (*Pinnaspis aspidistræ*, S) attacking coconut leaves from Coimbatore and the palm weevil (*Rhynchophorous ferrugineus*, F) from Porto Novo.

(12) *Cotton.*—The stem weevil (*Pempheres affinis*, F) and the spotted bollworms (*Earias* spp.) from Udamalpet; and the leaf roller (*Sylepta derogata*, Fb) from Perur.

(13) *Coleus* sp.—Mealy bugs (*Pseudococcus* sp.) from Coimbatore.

(14) *Crotons.*—Mealy bugs (*Pseudococcus virgatus*, C.) from Podanur.

(15) *Daincha.*—The tobacco caterpillar (*Prodenia litura*, Fb) from Tanjore.

(16) *Gingelly.*—The gall-fly (*Aspondylia sesami*, F) from Coimbatore.

(17) *Grasses.*—Cutworms (*Cirphis* sp.) from Hosur; *Hymenia fascialis*, C from Coimbatore and white ants from Hosur, Madras and Coimbatore.

(18) *Groundnut.*—The red hairy caterpillar (*Amsacta albistriga* W.) from Arur.

(19) *Jack fruits.*—The moth borer (*Glyphodes cæsalis*, Wilk) from Peravurni.

(20) *Jasmine.*—The jasmine bug (*Antestia cruciata*, F) from Sattur.

(21) *Lablab.*—Aphids from Coimbatore and mealy bug (*Pseudococcus virgatus*, C) from Coimbatore.

(22) *Mango.*—Mango hoppers (*Idiocerus* spp.) from Bombay, Chowghat and Coimbatore; the castor slug (*Parasa lepida*, Cr) from Coimbatore; the stem borer (*Batocera rubus*, L) from Coimbatore, Madras and Madura; thrips from Kodur and the shoot webber (*Macalla moncusalis*, Wilk) from Samalkot.

(23) *Paddy.*—The paddy borer beetle (*Rhizopertha dominica*, F) from Tirumalrayapatnam; *Leptispa pygmæa*, B from Coorg; the caseworm (*Nymphula depunctalis*, G) from Coimbatore; the earhead bug (*Leptocorisa acuta*, Th) from Pazhayannur and Perintalmanna and the stem borer (*Schoenobius incertellus*, W) from Tiruppur.

(24) *Palmyrah.*—The coconut caterpillar (*Nephantis serinopa*, M) from Bezwada and Kanapamula.

(25) *Ragi.*—Root aphis (*Tetraneura hirsuta*, B) from Coimbatore; cutworms (*Cirphis* sp.) from Coimbatore and *Spodoptera mauritia*, B from Thondamuthur.

(26) *Rose.*—Scales (*Aspidiotus* sp.) from Travancore.

(27) *Rubber.—Dermestes* sp. from Quilon.

(28) *Sunnhemp.*—The hairy caterpillar (*Utetheisa pulchella*, L) from Coimbatore.

(29) *Sugarcane.*—The cane borer (*Argyria sticticraspis*, H) from Battuvaripalle; mealy wings from Sullia and white ants from Erode, Pollachi and Kanjikode.

(30) *Sesbania speciosa.*—Borers (*Azygophleps scalaris*, F) *Sphenoptera perotetti*, G, and *Alcides bubo*, F from Coimbatore.

IV. Teaching.

B.Sc. Ag. Degree Course.—The following lectures and practical classes were held during the academic year 1939–40 :—

Class.	Lectures.	Practical classes.
Class I	61	32
Class II	32	25

The lectures were each of one hour duration and the practical classes of two-hour duration.

Short Course on Insect Pests.—Fifteen classes of three-hour duration were held for the students of the short course on insect pests from the 1st to 23rd November. Twelve students attended the course.

Short Course on Bee-keeping.—The usual short course on bee-keeping was conducted during February. Twelve students attended the course. In addition to this a special course was arranged for forty-one students of the Wardha Training School during March. The students were given training in both the theoretical and practical aspects of the subject.

V. Special Investigations.

Pests of cotton.

1. *The Cotton Stem Weevil (Pempheres) and its parasites.*—The abridged scheme under the auspices of the Indian Central Cotton Committee for investigating the possibilities of biological control of Pempheres came into operation on 31st October 1939 with the appointment of the Parasitologist. The earlier part of the year prior to the inception of the scheme was also devoted to the same studies to the extent possible with available facilities.

Incidence of pest and parasites in Cambodia cotton.—The material examined under this head consisted of a total of 6,730 plants from two fields—F. 68 Central Farm and Insectary, besides 442 plants examined prior to October 1939.

Month.	Central farm.		Insectary.	
	Percentage of infestation.	Percentage of parasitism.	Percentage of infestation.	Percentage of parasitism.
1939—				
October	..	..	..	..
November	15·63	..	5·30	..
December	5·21	..	48·89	..
1940—				
January	21·28	0·83	83·01	0·69
February	34·40	0·75	83.78	..
March	44·05	..	95·79	..
April	52·04	..	99·14	..
May	75·33	..	100·00	..
June	No crop.	No crop.	99·00	

The trend of incidence and parasitism is depicted in the table above. The first wave of influx of the pest became evident in November having probably commenced late in October. The incidence has been more rapid and heavy in the latter field. The population density reached its peak at the end of second generation in February with a decline beyond that period. Parasites were encountered only in January and February. *Euderus*, *Rhaconotus* and *Spathius critolans* formed the species. *Rhaconotus* is a new record from cotton.

Incidence of pest and parasites in alternate host plants.—A total of 6,545 plants under this category inclusive of 367 from Malabar belonging to 22 different species was examined for the period. Among these, 16 species showed infestations of which 14 yielded live stages. Three species—*Pavonia zeylanica*, *Corchorus acutangularis* and *Sida cordifolia* constitute new records.

Plant species.	Percentage incidence.		Percentage parasitism.	
	Average.	Maximum.	Average.	Maximum.
Triumfetta rhomboidea ..	51·89	75·00	11·47	44·64
Malvastrum coromandelianum	4·63	16·60	..	..
Hibiscus vitifolius	9·85	26·00	1·39	16·67
H. ficulnens	0·41	5·00	..	..
H. micranthus	6·60	33·00	doubtful host.	
Urena lobata	15·50	66·60	..	..
U. sinuata	2·38	14·29	..	..
Pavonia zeylanica	5·10	33·30	2·00	18·10
Corchorus olitorius	5·06	28·50	3·00	33·30
C. acutangularis	7·23	75·00	..	..
C. trilocularis	9.04	28·50	doubtful host.	
Sida acuta	6·49	35·00	5·55	66·60
S. glutinosa	7·58	18·75	..	..
S. spinosa	9·50	40·00	..	..
S. rhomboidea	4·70	20·00	..	..
S. cordifolia	16·60	100·00	..	..

Parasitism was for the first time discovered in *Pavonia*. One hundred and seventy-five parasites made up of 115 *Entedon*, 35 *Dinarmus*, 9 *Spathius labdacus*, 6 *Spathius critolans*, 6 *Rhaconotus*, 1 *Euderus*, 1 *Bruchocida* and 2 undetermined Chalcids were collected. *Entedon* occurs throughout the season; *Dinarmus* was absent in September-November and January-February; *Spathius labdacus* only from November to March; *Rhaconotus* in May-June and November; rest occur only occasionally.

Distribution of pest in cotton and alternate host plants.—North Arcot, Salem and Malabar form the three districts explored. Pempheres as a pest of cotton does not occur in South Arcot although alternate host plants like *Hibiscus esculentus* do harbour the weevil showing that it is a potential menace to cotton. It is a pest of cotton particularly serious in " Nadam " variety in Salem district. From Malabar, *Triumfetta rhomboidea*, *Sida acuta*, *S. rhomboidea*, *Hibiscus esculentus*, *H. sinuata* and *Urena sinuata* were taken heavily attacked by the weevil in forest regions that would seem to suggest its indigenous character.

Studies on parasites.—Additional new data on parasites, their distribution, seasonal incidence, association with new plant hosts, their biology, etc., have been gathered. Host selection of *Spathius critolans*, life cycle of *Entedon*, *Dinarmus*, *Euderus* and *Spathius labdacus* and their comparative abundance in virgin forests in Malabar have been elucidated. A new host plant association of the Nematode parasite was discovered. An unidentified new Chalcid parasite was noted.

2. *The Cotton Bollworms (Earias and Platyedra)—Incidence of bollworm infestation in the shed buds and bolls in Cambodia cotton.*—The above studies were started on the 16th December 1939 in field No. 68, Central Farm, and continued up to the 15th February when they were discontinued owing to dearth of material. The shed material was daily gathered from a six cent plot and examined for insect damage. The incidence of spotted bollworms reached the peak of 51·3 per cent in buds and 38·9 per cent in bolls in the first week of January. The infestation by the pink bollworm was also heaviest in the first week of January with 6·1 per cent in buds and 4·8 per cent in bolls. Thereafter there was a pronounced decrease in the infestations even though the volume of shed material remained as high as ever. At the end of January and beginning of February the infestation percentages touched a very low figure, viz., 1·7 per cent and 1·9 per cent in buds and bolls, respectively, for the spotted bollworms and 9 per cent and 2 per cent for the pink bollworm. The disease caused by *Bacteria malvacearum* showed again rather severely from the middle of January in both buds and bolls.

Incidence of bollworms in burst kapas.—For this purpose, 150 kapas were picked at random from each of the eight six-cent plots and examined for bollworm damage. The percentages of incidence for the ten pickings were as follows :—(1) 76·0, (2) 85·5, (3) 84·0; (4) 65·2, (5) 52·5, (6) 49·3, (7) 50·8, (8) 55·4, (9) 53·2 and (10) 51·0. The damage was more pronounced in the first four pickings and there was a slight falling off in damage in the subsequent pickings. Damage due to the spotted bollworms appears to be higher in the initial pickings while that due to the pink bollworms is higher in the later pickings.

Imperfect opening of bolls.—Studies into the causes of the defective opening of bolls were started in February. A few plants were enclosed in wire gauze cages and in one cage spotted bollworms were introduced and in another pink bollworms and a third was kept as control. In the control cage the burst kapas were totally free from damage of any kind. In the *Earias* cage bursting was equally good and there was no damage of any kind in the kapas; presumably the larvæ have failed to get into the bolls and must have perished. In the cage where the pink bollworm caterpillars were liberated there was observed defective opening of the bolls in which the damage by larvæ was evident.

The extent and causes of the imperfect opening of the bolls were also studied from the field material. The sixth, seventh and eighth pickings on 6th March 1940, 15th March 1940 and 25th March 1940 gave 38·8 per cent, 34·4 per cent and 25·4 per cent, respectively, of imperfectly opened kapas. The table below shows the agents of damage :—

Agents of damage.	Sixth picking.	Seventh picking.	Eighth picking.
	PER CENT.	PER CENT.	PER CENT.
Bollworms alone	42·7	40·1	50·3
Bollworms and fungus	29·8	27·5	25·7
Fungus alone	..	..	..
Other causes	27·5	32·4	24·0

Studies on the bollworm parasites.—The spotted bollworms (*Earias fabia*) in cotton buds were found subject to parasitization in the field by the following parasites :—*Microbracon lefroyi*, D. and G., *Rhogas aligharensi*, *Bassus* sp. (*Braconidæ*), *Actia hyalinata* Mall (*Tachinidæ*) and those in *Hibiscus vitifolius* pods by *Elasmus johnstoni and Microbracon greeni* (Ash). The following are the parasites recovered from pink bollworms (*Platyedra gossypiella*) infesting cotton buds, flowers and bolls under field conditions; *Microbracon gelechidiphagus* Ramk, *Apanteles pectinophoræ*(?) and *Goniozus* sp. The latter is found more prominently associated with the caterpillars infesting open and closed flowers. Observations made this year go to confirm what had been made last season as regards the specificity of *Microbracon lefroyi* to attack the spotted bollworm (*Earias fabia*) in cotton buds.

The biology of the following parasites has been worked out :—*Microbracon lefroyi*, D and G., *M. greeni* (Ash) *M. gelechidiphagus* Ramk, *Elasmus johnstoni* and *Goniozus* sp. The first named appears quite early in the season and keeps on till January and then fades out; *M. gelechidiphagus* which exclusively parasitizes the pink bollworms in big bolls appears somewhat late in the season, i.e., after February.

Larval diapause in the pink bollworms.—Diapause in the larval stages of the pink bollworm has been noted in the caterpillars picked from ripe bolls in March-April. Some continue to retain the diapause

condition while others have pupated and emerged as adults after a period of 90 days.

3. *The cotton flower weevil* (*Amorphoidea arcuata*).—This insect was found breeding in tender bolls and the damage done to them by the grubs is more or less similar to that caused by the pink bollworm. This is the first time that the weevils have been noted to breed in bolls. An allied species of *Amorphoidea* (*A. lata*) has been noted to be the most serious pest of cotton squares and bolls in the Philippines. Though the incidence of *A. arcuata* is at present negligible, the situation due to the presence of this weevil here requires watching.

Pests of sugarcane.

Moth borer control experiments—(a) Earthing up of young canes.—As counts of infestation taken fifteen days after earthing up of young cane shoots gave statistically significant results during the previous year, experiments have been started to study the effects of two earthings up in the earlier stages of the crop. The work is in progress.

(*b*) *Eggmass collection.*—When the plants were about a month old eggmasses were collected once in three days for about two months. Counts of infestation were made both in treated and control plots. The results were not statistically significant. In view of the prohibitive cost of treatment (Rs. 60 per acre) this method of control has to be discarded.

(*c*) *Breeding of Trichogramma egg parasites.*—Mass breeding of the egg parasite—*Trichogramma minutum*—is in progress for liberation in affected cane fields.

Varietal resistance studies.—During the year under report Co. 413, Co. 419, Co. 417 and Poj. 2878 raised in the Central Farm in replicated randomized plots were examined at the harvest time and the incidence of the borer (*Diatræa venosata*) recorded. The mean percentages of attack in whole canes and joints from the four varieties are furnished below :—

Varieties.	Canes.	Joints.
	PER CENT.	PER CENT.
Co. 413	63·9	5·9
Co. 419	52·6	9·0
Co. 417	84·4	12·2
Poj. 2878	64·3	9·2

From the analysis of variance of percentages of canes attacked it will be seen that the varieties have shown significance for attack. The attack in Co. 417 was significantly higher than in others.

Analysis of variance of percentages of canes attacked.

	Degrees of freedom.	Sum of squares.	Mean squares.
Varieties	3	2,401·47	800·49
Block	3	339·45	113·15
Error	9	878·58	97·62
Total ..	15	3,619·50	

Natural enemies of moth borers.—The following parasites were noted during the year :—*Egg parasites—Trichogramma minutum* on *Argyria sticticraspis* and *Diatræa venosata, Telenomus* sp. and *Tetrastichus* sp. on *Scirpophaga. Larval parasites—Apanteles flavipes* on *Scirpophaga* and *Diatræa* and *Shirakia* sp. on *Scirpophaga. Pupal parasites—Tetrastichus ayyari* on *Argyria stricticraspis* and *Diatræa venosata* and *Trichospilus* sp. on the latter.

Life history studies.—Detailed studies of the life history and habits of *Diatræa venosata* were concluded during the year. As details of the life cycle of *Argyria sticticraspis* were lacking this was taken up during the year. A study of the habits of the pest has shown that it is capable of infesting new shoots of old clumps. As high as 14 per cent infestation has been recorded in the case of one month old new shoots of the old clumps. As such the old clumps are a source of infection to the newly planted crop.

Work of regional survey staff at Gudiyattam and Anakapalle (I.C.A.R. Scheme).—The staff stationed at Gudiyattam worked throughout the year while that at Anakapalle was disbanded on the termination of the scheme. Survey of cane areas round about Gudiyattam and Anakapalle was made for noting the relative importance of the various species of cane borers and their seasonal incidence. The different natural enemies were also noted. Observations on the influence of weather conditions and cultural methods on the incidence of borers were made. A detailed account of the work done will be given in the scheme report.

Pests of chillies.

The chillies thrips (Scirtothrips dorsalis Hood)—Varietal resistance to thrips attack.—Two varieties Guntur 399 and 367 and the locals were planted on the 24th and 25th August in four replicated blocks. Each plot measured 45 feet by 12½ feet and carried five rows of 30 plants each. The seedlings were not given any insecticidal treatment either in the field or in the nursery. Owing to the continued severe drought thrips attack was very severe in all the varieties; the planted seedlings therefore showed very severe curling. The Guntur varieties which were known to be resistant at Guntur have broken down and fared worse; they succumbed in course of time in view of heavy mortality in them. Trials with more varieties are in progress.

Paddy pests.

The paddy stem borer (Schœnobius incertellus, W.)—Light trap trials.—Studies on the control of the borer by light traps were conducted at the Central Farm wet lands, Coimbatore. During the year under review, the trial was extended also to Vadavanur in Palghat taluk in a double crop area. At the Central Farm there were 58 days of trapping and 1,427 moths were got. There were two strong broods one in October and the other in November. The average incidence as shown by the presence of white ears in December 1939 within a radius of 360 yards was 1·4 per cent whereas that outside this range was 2·8 per cent.

At Vadavanur, the trapping was effected from October 8th to February 6th a period of four months. In the course of 106 days of trapping 25,297 moths were collected and destroyed. The results of the trials have shown that irrespective of the varieties grown the average incidence as judged by the presence of white ears within a radius of 550 yards from light was only 2·5 per cent whereas that outside this range was found to be 11 per cent with an appreciable difference of 85 per cent.

Pests of fruit-trees.

1. *The Ber fruit flies (Dacus correctus and Carpomyia vesuviana) —Raking up the soil to control fruit flies.*—Studies on the control of ber fruit flies at Panyam have shown that in blocks where the soil was raked up to destroy the pupæ in March-April the fly incidence in the fruits ranged from 36 per cent to 55 per cent while in non-treated blocks the incidence varied from 60 per cent to 100 per cent. The treatment would have given better results if the whole area had been brought under operation.

Varietal resistance studies.—It has been found that a few trees showed remarkable resistance to fruit fly attack while the neighbouring trees had in some cases cent per cent attack. At our suggestion the resistance observed in these few trees is being utilized for budding purposes.

Alternate hosts.—Of the two species of flies infesting *ber*, *Carpomyia vesuviana* is the more important. Search for alternate host plants of *Carpomyia vesuviana* has not been successful while *Dacus correctus* was found to breed in the fruits of *Capparisa separia*, *Carissa carandá* and *Streblus asper.*

Life history studies.—Life histories of both the species have been worked out. *Carpomyia vesuviana* remains as a maggot inside the puparium in the soil for nearly 287 days. As many as 170 live puparia have been secured in an area of 2 square yards of soil under a tree.

2. *The Ber weevil (Aubeus* sp.).—Some of the stunted fruits in *ber* trees, on examination, showed the presence of the weevil. The weevil grubs attack the fruits in the very tender stages and as a result of the attack the fruits do not attain the normal size. This seems to be a new record for South India.

3. *The mango fruit flies* (*Dacus ferrugineus*).—Control trials against the fruit flies at the Agricultural Research Station, Kallar, consisted of raking up the soil round about the trees and spraying of poisoned molasses at the time of the emergence of adult flies. The results of the trials were every successful.

4. *The citrus fruit sucking moth* (*Ophideres* spp.).—Our previous studies have indicated that the fruit sucking moth shows distinct preference to tomatoes as against citrus fruits. Growing of tomato as a trap crop was attempted at a few centres. Favourable reports have been received from Kodaikanal and Cuddapah.

5. *The Woolly Aphis on Apples* (*Eriosoma lanigera*).—Spraying of insecticides against *woolly aphis* on apples in the Pomological Station, Coonoor, had shown that the insecticides had no lasting effect on the pest and had therefore to be repeated to give successful results. So consignments of *Aphelinus mali*—parasite of the woolly aphis—were got from the Punjab Entomologist for introduction into the affected gardens. The first lot failed to breed; the second which was received about the middle of April established itself. The parasites were bred in a wire gauze field cage and two generations have been obtained therefrom. Side by side with breeding in field cages, some were allowed to parasitise woolly asphis on the trees themselves. It is gratifying to note that the parasites are thriving. After they have been bred in large numbers colonies of these parasites will be distributed to other infested apple gardens in the Nilgiris.

Pests of groundnut.

1. *The groundnut surul* (*Stomopteryx nerteria*).—Studies on this pest were made at the Agricultural Research Station, Tindivanam.

Varietal resistance studies.—Thirty-five types of groundnut including important bunch and spreading varieties and selections were under study for resistance to surul. In the selections of spreading varieties the types showed significant difference. No selection was seen to be free from attack. A.H. 669 was found to be the least attacked and A.H. 622 the most susceptible for the season.

Light trap trials.—Light trap trials have indicated (i) that Petromax (300 C.P.) gives better catches than Hurricane light, (ii) that white light attracts more moths than green and red lights, (iii) that light at ground level attracts more moths than that kept at 5 feet and 10 feet above the ground level, (iv) that a Hurricane light at ground level attracts more moths than Petromax at 5 feet and 10 feet above the ground level, (v) that more moths are attracted from 6-30 to 10-30 p.m. and 2-30 to 4-30 a.m. than at other periods of the night, and (vi) that light traps registered high catches of moths from June to December-January, the highest being in September.

Effect of surul attack on yield.—Yields were taken from pest free (handpicked) and attacked plots of A.H. 32 in randomized replicated plots. When the figures were analysed it was found that

the difference in yields was not significant. This may be due to the adverse effect caused to the picked plots in the course of hand-picking. This factor will be avoided in the future experiments.

Studies on the life history and habits of the pest and parasites.—Life cycle of the pest was studied every month. During most of the months it ranged from 15 to 25 days while in December 1939 and January 1940 it was 26–30 and 23–31 days respectively. The maximum longevity was 36 days. The maximum and minimum number of eggs laid were 233 and 43. Five generations of the pest were passed in groundnut during the season. The life history of two parasites *Microbracon* sp. and *Perisierola* sp. was worked out during the season.

2. *The stored groundnut pests.*—An examination of groundnut godowns in Cuddalore has revealed the presence of four species of beetles affecting kernels. The pests feed on the kernels and reduce them to a powdery mass. The life cycle of one of the beetles was studied and found to be 56 days, the egg, larval and pupal periods being 4, 45 and 7 days respectively. The maximum longevity was 63 days.

Pests of gingelly.

The gingelly caterpillar (Antigastra catalaunalis)—Varietal resistance studies.—Ten varieties sown in two series consisting of five varieties each replicated six times were studied for resistance to *Antigastra* caterpillar attack. Selection S.I. 6. 2. 133. I was found to be attacked most while S.I. 882 was observed to be the least attacked.

Studies on life history and habits of the pest and parasites.—The life cycle of the pest ranged from 19–26 days, the egg, larval and pupal periods being 4–5 days, 11–16 days and 4-7 days respectively. The maximum longevity was found to be 15 days and the maximum number of eggs laid was 137. Seven larval parasites, viz., an Ichneumonid, *Apanteles pectinophoræ, Goniozus* sp., *Microbracon hebetor;* one larval predator—*Rhinocoris fuscipes* and *one pupal* parasite—*Brachymeria* sp. were noted and of these, *Microbracon hebetor* and *Goniozus* were studied in detail.

Pests of castor.

The castor semilooper (Achaea janata).—There were four heavy emergencies of the pest during the season. The first brood was observed in the last week of September and the last in the first week of December. Handpicking of the caterpillars was done to check the pest. To find out how the pest tides over the off-season some caterpillars were put into a wire gauze cage for pupation in the soil and they are under observation.

Pests of cholam.

The freckled yellow disease of cholam.—The control of the disease by raising non-cereal border crops all round the sorghum field with the object of preventing the fulgorid vector coming from the bunds and thus reducing the incidence, was given a trial at the Millets

Breeding Station. Sowing of *Crotalaria juncea* and *Sesbania speciosa* was done in the borders simultaneously along with the bulk sowing of sorghum on August 9th and 10th. The border crops did not put up good growth until after receipt of rains in September. Counts taken for the incidence of the disease in December 1939 from the 14 two cent plots in the field, have shown that the border crops have not been helpful.

Pests of tobacco.

The tobacco caterpillar (Laphygma exigua HB) and its control.—Ragi trap beds were put up in the off-season in the Chirala nursery in July but they were not able to attract the moths in appreciable numbers. However, these were destroyed with the pest on long before the main sowings which were due in August. The improved method of pest control, namely, the alternate sowing and pulling up ragi seedlings on the edges of the tobacco beds at intervals of four days was adopted and found to have given good results.

Pests of coconut.

The coconut beetle (Oryctes rhinoceros) control studies.—*(a) Collection of beetles and sanding of beetle holes.*—Observations were made in the treated and control plots consisting of 15 trees each; the treatment to the trees consisted in the removal of the beetles by barbed prods and sanding of the holes while in the control it was restricted to the collection of beetles alone. The figures for degree of attack and the number of beetles collected both in the treated and control trees are given below. It will be seen that in the treated trees (i) the number of beetles is less, (ii) the number of new beetle holes is less, and (iii) the old beetles holes are seldom retenanted.

Month.	Number of new holes.		Number of beetles collected.				Total number of beetles collected.	
			New holes.		Old holes.			
	Treated.	Control.	Treated.	Control.	Treated.	Control.	Treated.	Control.
1939.								
July	7	2	2	..	..	1	2	1
August	5	13	2	3	..	..	2	3
September	3	8	2	6	..	6	2	12
October	10	11	4	6	1	5	5	11
November	9	13	4	8	..	2	4	10
December	2	7	2	6	1	5	3	11
1940.								
January	2	6	1	3	..	..	1	3
February	..	2	..	1	..	3	..	4
March	1	10	..	1	..	2	..	3
April	..	9	..	8	..	6	..	14
May	2	6	1	4	1	6	2	10
June	3	3	2	1	5	6	7	7
Total ..	44	90	20	47	8	42	28	89

(*b*) *Biological control.*—Studies on the green muscardine fungus parasitic on beetle grubs were continued; these have shown that the fungus remains viable for 18 months in dung kept in pots. Dung from field pits inoculated with the fungus two years ago was tested in pots with beetle grubs when these were found affected. Test pits were opened one in each of the four Agricultural Research Stations on the West Coast with co-operation of the Oil Seeds Specialist and inoculated with the fungus. The grubs were found affected in three out of four pits. From the observations made so far only a few grubs were found acted upon though the fungus was present in the pits. The exact cause for the failure of the fungus to act on a larger number of grubs is being investigated at the Insectary by a new set of experiments.

Pests of cardamoms.

The cardamom thrips (*Taeniothrips cardamomi Ramk*) *control experiments.*—Since scabs in well developed pods are the result of thrips damage to the tender pistils in the blossom stage and since pods take nearly 4 to 5 months for reaching full maturity the good effects of spraying in controlling the thrips and reducing the scab injury will only be seen in the pods picked four months after treatment. There have been in all five pickings but the fifth picking being very poor has not been taken into account for experimental purposes. The table below gives the figures for good and bad pods on percentage basis (mean average for the six plots of each treatment).

Treatments.	First picking 13th October 1939.		Second picking 10th November 1939.		Third picking 15th January 1940.		Fourth picking 15th February 1940.	
	Good.	Bad.	Good.	Bad.	Good.	Bad.	Good.	Bad.
Sulphur dusting ..	61·4	18·8	52·4	32·2	55·6	19·6	65·1	15·1
Tobacco decoction spraying	56·9	26·2	59·4	11·9	80·9	8·4	78·6	9·3
Potash fish oil soap spraying	49·3	25·8	48·5	18·0	64·0	14·1	67·3	13·7
Bordeaux mixture spraying	44·3	38·0	44·4	29·4	63·0	13·6	59·4	19·4
Control	45·3	36·5	43·4	43·0	64·6	16·6	60·6	20·8

The tobacco decoction treatment has uniformly given good results. Figures for good pods are higher in the first two pickings when compared with those of the controls. Judged from the bad pods the treatments have registered low percentages as against controls. High figures for good pods in the third and fourth pickings in the controls indicate that thrips must have been very low in the months of September and October at which period the setting of those pods had taken place. Field observations made then also go to confirm the above assumption. Thrips populations continued to be low in November-December.

Mosaic vector studies have not given hopeful results so far. In addition to thrips, suspicious insects like the jassid *Tettigoniella ferruginea* and the aphids have been collected for further studies in this direction.

Pests of pepper.

Pollu disease of pepper.—Experimental trials with five fungicides and two insecticides with appropriate controls were made on pepper in Payyanur, North Malabar, against pepper pollu disease. The following are the fungicides and insecticides used in the trial: *Fungicides*—(1) Bordeaux mixture (1 per cent) with coconut oil as adhesive, (2) Bouisol (0·33 per cent), (3) Kupoid (0·28 per cent), (4) Peronox (0·5 per cent), and (5) Mycol (0·36 per cent). *Insecticides*—(1) Crude oil emulsion (1·25 per cent), and (2) Calcium arsenate (0·47 per cent). All other treatments excepting Mycol in the fungicide group have not given encouraging results; Calcium arsenate appears to exert a deleterious effect on the vines inducing heavy spike fall.

Pests of jasmine.

The jasmine mite (*Eriophyes* sp.).—More extensive experiments for the control of jasmine mite were started at Tudiyalur with a view to find out the cost of treatment and the quantity of insecticide required for a plot of 35 bushes and whether the addition of diluents like wood ashes to the insecticide would secure reduction in the cost of treatment without impairing the effectiveness of the treatment. Experiments are now in progress. From the results so far obtained in the treated bushes seem to be free from blisters when compared with untreated bushes in the neighbouring gardens.

Pests of stored grains.

The experiments on the storage of cholam and paddy grains to keep the grains free from insect pests were concluded during the year under report. The following are the results of the studies: (1) Paddy in storage does not suffer so much from pests as cholam. (2) Of the various pests of paddy and cholam, viz., *Calandra*, *Rhizopertha* and *Tribolium* the first named is the most numerous and serious pest of cholam while *Rhizopertha* is the most important pest of paddy. (3) The incidence of *Calandra* in general showed a slight rise in April to June, a fall in the next three months and a rise again in October to December. There was no such definite rise or fall in the population of *Rhizopertha*. (4) Regarding the results of the various treatments sun drying once a month was by far the best method of protecting the seeds from pests in cholam while, barring Acorus and Derris, it was better than the rest for paddy pests. The use of neem leaves generally adopted by the ryots does not seem to be so satisfactory.

Insecticidal trials.

Dusting of sulphur against *Saissetia nigrum* scales was not effective while it was effective against nymphs of *Pseudococcus virgatus*. 'Acme' Lead arsenate gave satisfactory results against *Prodenia* caterpillars. Dried Pyrethrum flowers got from Kotagiri were finely powdered and tried against *Prodenia* and *Plutella* caterpillars with

striking success. Dried roots of *Derris elliptica* plants raised at the Insectary were similarly powdered and used against Epilachna beetles and aphids on lablab, bottlegourd and chrysanthemum. There was high mortality in all the above insects.

Chemotropic response of insects.

The trials were continued with Citronella, Eucalyptus, Lemon grass oil, terpenol and cinnamon in Minnesota traps. Of these, oils of Citronella and Clove attracted the males of *Dacus correctus* to a limited extent. Trials with sugars have not proved helpful in attracting pests of crops.

Electroculture.

Trials were made against Lasiocampid caterpillars on Sapota, Aphids on Chrysanthemum, mealy bugs on sugarcane, etc., but the results were not satisfactory.

VI. Life History Studies and Pest Control Work at headquarters.

The life histories and habits of insects collected by the staff and those received from outside were studied at the Insectary. Of the more important insects which received special attention, the following may be mentioned :—

(1) Ber fruit flies (*Dacus correctus* and *Carpomyia vesuviana*).

(2) The wax beetle (*Platybolium alvearium*).

(3) The cotton stem weevil parasites (*Entedon* sp. ; *Dinarmus* sp. ; *Euderus* sp. and *Spathius labdacus*).

(4) The cotton bollworm parasites (*Rhogas aligharensi*, *Microbracon lefroyi* and *M. greeni*).

(5) The sugarcane moth borer parasites (*Amyosoma*, *Chelonus* sp. ; *Telenomus* sp. and *Tetrastichus* sp.).

(6) The cotton flower weevil (*Amorphoidea arcuata*).

(7) Groundnut surul and parasites (*Goniozus* sp. and *Microbracon hebetor*).

(8) The Sesbania borer (*Sphenoptera perotetti*).

(9) *Pachyneura* sp. egg parasite of *Scutellera nobilis*.

(10) *Chelonus* sp. egg parasite of *Prodenia litura*.

(11) *Pericyma glaucinans* on Daincha.

(12) *Clavigralla gibbosa* on redgram.

Insect control work carried out at headquarters was mainly in response to calls received from the Central Farm and the breeding stations. The small plots of different crops grown at the Insectary

field for entomological studies also received attention. The following are some of the important pests dealt with :—

Parasa lepida on mangoes; *Laphygma exigua* and *Sylepta derogata* on cotton; *Prodenia* on castor; aphids on house beans; mango hopper; brinjal Epilachna; mealy bugs and scales on crotons; Psyllids on curry-leaf; thrips on chillies; *Nephantis* on coconuts; the paddy caseworm; and white ants attacking grass lawns.

VII. Bee-keeping.

Bee-keeping as a cottage industry is gaining rapid popularity. This is shown by the progressive increase in the number of hives in this Presidency for the last four years as shown below :—

Circle.	1936.	1937.	1938.	1939.
I	104	231	599	421
II	24	79	96	257
III	123	455	924	1,958
IV	757	989	1,273	1,687
Total ..	1,008	1,754	2,892	4,323

Apiary.—Work in connexion with bee-keeping showed considerable progress during the year. An average strength of about 40 colonies was maintained at the Apiary for experimental and demonstration purposes. Unlike the previous year the weather and pasturage conditions were quite favourable during the year under report. On the whole, 199 lb. of honey were extracted. The average yield per hive was 7 lb. and the maximum a hive gave was 15 lb. 2 oz.

Research.—Research on various aspects of bee-keeping was continued. The more important items of work are given below.

Bee enemies.—Studies on the wax beetle and the lesser wax moth have shown that, according to South Indian conditions, they very rarely assume the status of serious pests and that even the little damage done by them can be checked by cleaning the base board once a week.

Bee pasturage.—The following new bee pasturage plants were noted during the year :—

Pollen—Poinciana elata, Mymosa pudica, and *Argemone mexicana. Nectar—Sesbania grandiflora, Eriodendron aufructiosum, Tephrosia purpurea, Cratœva religiosa, Cetherexylon subserratum, Santalum album, Sapindus emarginatus, Linseed,* Berseem and *Ligustrum roxburgii.*

Hill bees.—Previous experience has shown that the hill variety of the Indian bee when introduced into the plains continued to be a better honey gatherer but there was no tendency in them to stay.

So an attempt is being made to cross the hill variety with the plains variety with a view to improve the staying habit of the former and the honey gathering capacity of the latter.

Swarm prevention.—Trials of swarm prevention by (*a*) provision of additional breeding space either by increasing the size or number of brood chambers, (*b*) periodical removal of the brood combs to provide adequate work for the queen, and (*c*) dequeening and requeening were made. Of the above methods tried, increasing the number of brood chambers alone gave slightly encouraging results.

Artificial feeding.—At times when bee pasturage is very scanty there will be necessity for resorting to artificial feeding. Sugar solution is easily accepted by the workers as a substitute for nectar but they do not take to pollen substitutes like wheat and Bengalgram flour, etc. Therefore trials with other substances are in progress.

Studies on the response of bees to environmental factors.—The above studies were concluded during the year. It is found that the availability of pasturage and the time of opening of the flowers were the most important factors that govern the activity of the bees. Significant positive correlations were noted to exist between pollen and humidity and nectar and weight and negative correlation between pollen and temperature and nectar and temperature.

Rock bee honey extraction and preservation.—Trials in this connexion were concluded during the year. Of the appliances tried, viz., honey press, honey strainer and honey extractor the latter was found to be the best. Trials on the preservation of honey have shown that artificial ripening and storage in clean airtight receptacles were necessary to prevent fermentation.

Propaganda.—Numerous enquiries for advice and help continue to come from all parts of the Presidency and also from other parts of India. Personal advice was given wherever possible and in other cases adequate information was given by correspondence. The section took part in a number of exhibitions and fairs. To give a further stimulus for the rapid spread of the industry the third Annual Honey Week was celebrated all over the Presidency during January 1940. At Coimbatore the function was inaugurated on the 18th evening by P. M. Kharegat, Esq., C.I.E., I.C.S., Vice-Chairman of the Imperial Council of Agricultural Research. A comprehensive exhibition was also arranged for the occasion and it was kept open for a week. The comb foundation mill which was recently obtained from America is a useful acquisition to the section. In all 50 lb. of comb foundation sheets were prepared of which 40 lb. were supplied to departmental officers and the public. The following articles were distributed by the section: Bee hives 5; bee colonies 2; honey extractors 4; bee escapes 24; queen excluder sheets 34 square feet; bee smoker 1; dummy board 2; drone traps

3; honey 31½ lb.; and departmental bulletin on beekeeping (Tamil) 16. Owing to the limited budget allotment available for the section, a large scale distribution of the appliances to the public could not be taken up. Arrangements were however made with a local firm to manufacture the requirements and supply the parties direct after our scrutiny. District officers are also making their own arrangements for the supply of some of their common requirements.

The Government have been pleased to extend the bee-keeping scheme for Chittoor district in view of the importance of this industry.

VIII. Ericulture.

Rearing of eri silkworms was continued throughout the year for supplying eggs to rearers in different parts of the Presidency and also for demonstration to students. It is possible to market the cocoons now; the Mysore Spun Silk Company, Limited, Chennapatna, Mysore State, are prepared to pay 8 to 12 annas per lb. of pierced cocoons depending on the quality.

IX. Quarantine Service.

During the year under review, 75 lots including samples of seeds, bulbs, live plants, etc., were examined for insect pests, fumigated wherever necessary and certificates issued. These lots included materials intended to be sent by the officers of the department and others to countries outside India and those imported into India from outside.

X. Systematic Studies and Collections.

Systematic studies on Hymenopterous parasites, Coccinellidæ, Bruchidæ and Acarina were continued.

Detailed examination was made to find out that taxonomic differences between *Microbracon lefroyi* and *M. Greeni;* the ovipositor in the case of the latter was found to be nearly one and a half times as long as the abdomen whereas in *M. lefroyi* it was hardly as long as the abdomen. A small consignment of field bred *M. greeni* was obtained from the Lac Research Institute for the above investigation; it is now found that the local species of *M. greeni* was not identical with that of Namkum. Further investigation is being made. The following parasites were found to be new to our collections :—(1) *Brachymeria plutellophaga* Gir, (2) *Eupelmus* near *anpingensis* Masi, (3) *Meteorus bœcorensis* Ash, (4) *Hormius* n. sp., (5) *Aulasaphes psychidivorus*, (6) *Perisierola* n. sp., and (7) *Chelonus* n. sp. near *malayana.* Scymnus group of Coccinellids in our collections was found to contain representatives of the following genera, viz., *Pullus*, *Scymnus*, *Pharoscymnus* and *Nephus.* Bruchids in the collections were studied. They contained the following unrecorded species :—*Bruchus rufimanus* Boh, *B. walkeri* Pic, *B. sparsimaculatus* Pic and *B. pauper Boh.* Mite pests of crops also received some attention.

During the year under review, one consignment each of insects was sent for identification to the Imperial Institute of Entomology, London, and Bureau of Entomology, Washington. Three consignments each of named insects were received back from them. Small consignments of insects were also sent to the Imperial Entomologist, New Delhi, for identification. We are indebted to all these authorities for the help rendered by them. Besides these, small lots of insects were identified by us for various parties including Entomological Assistants stationed in the districts. Specimens of insects reared at the insectary were incorporated into the collections. Rhynchota mixed collections were sorted out into families. Cataloguing of the family Curculionids was in progress. Twenty-five tubes of Aphids and a small collection of Hymenopterous parasites were sent to the Imperial Entomologist for his collections.

XI. Propaganda and Campaigns.

Much progress has been made in the demonstration of remedial measures against insect pests since the deputation of our assistants and those of the Mycologist who had received training in Entomology for work in the districts under the administrative control of the Assistant Directors of Agriculture. By this arrangement it has been possible to give timely help in the control of pests to the ryots. The assistants were actively associated in the organization of pest campaigns, exhibitions, etc., and in charge of Pest Act operations. They also studied insect pest problems peculiar to the tract as time permitted. A short account of the work of the assistants in the districts is given below.

In the First Circle, entomological work was done by the assistants stationed at Samalkot, Narasannapet and Bezwada. The Assistant at Samalkot had done commendable work in beekeeping and pest control problems. The pests dealt with by him covered a wide range such as Fulgorid (*Nilaparvata*) caseworm and *spodoptera* on paddy; *Prodenia* and aphis on tobacco; *Arbela* on citrus; *Nephantis* on coconuts; cane borers and groundnut hairy caterpillar. The assistant at Narasannapet attended to the gall-fly and caseworm of paddy; fruit sucking moths; *Epilachna* on brinjal; the groundnut hairy caterpillar, etc., in addition to beekeeping.

In the Second Circle, the assistants stationed at Cuddapah, Bellary, Nellore and St. Thomas Mount made themselves useful by giving relief to the ryots in the control of pests such as Jasmine bug, Deccan grasshopper, chillies thrips, lablab aphis, cane borers, paddy gall-fly, mango hoppers, *Nephantis* on coconut and palmyrah, fruit flies on melons and citrus *Epilachna* on brinjals and betelvine bug. The popularising of beekeeping in Madras and its environs is due mainly to the efforts of the staff at St. Thomas Mount. They also spent some time in passing consignments of tamarind for export to Egypt.

In the Third Circle, the following were the important pests attended to by the staff at Tinnevelly, Madura and Cuddalore—jasmine bug; pomegranate fruit borer; chillies thrips; brinjal epilachna; mango hopper and leaf webber; citrus aphids; coconut; beetle and weevil and *ophideres* on tomato. Work on beekeeping also showed some progress.

In the Fourth Circle, the needs of Coimbatore and Nilgiris were met by the headquarters staff while the assistants at Tirupattur and Tellicherry looked after the rest of the circle. The coconut caterpillar, groundnut hairy caterpillar, castor semilooper, chillies thrips, citrus aphids, the grapevine flea beetles and paddy case-worm formed the important pests dealt with.

XII. Scientific Papers published and prepared.

A. The following papers which were prepared and submitted previously were published during the year :—

(1) *Noorda moringae Tams.*—A new pyralid pest of *moringa pterygosperma*—by M . C. Cherian and Muhammad Basheer, published in the Indian Journal of Entomology, Volume I, Part 3, December 1939.

(2) Studies on *laphygma exigua* Hb and its natural enemies—by M. C. Cherian and M. S. Kylasam, published in the Journal of the Bombay Natural History Society, Volume XLI, No. 2, December 1939.

(3) *Achroia grisella* Fabr and its status in South India—by M. C. Cherian and S. Ramachandran, published in the Journal of Bombay Natural History Society, Volume XLI, No. 3, April 1940.

(4) *Tetrastichus ayyari* Rohw—a pupal parasite of some moth borers of South India—by M. C. Cherian and C. K. Subramaniyam, published in the Indian Journal of Entomology, Volume II, Part I, June 1940.

(5) The wax beetle—*Platybolium alvearium* B—in South India—by M. C. Cherian and V. Mahadevan, published in the Madras Agricultural Journal, Volume XXVIII, No. 6, June 1940.

(6) *Spathius vulmificus* Wlk—a possible parasite of the cotton stem weevil (*Pempheres affinis*)—by P. N. Krishna Ayyar and P. S. Narayanaswami, published in the Indian Journal of Entomology, Volume II, Part I, June 1940.

B. The following papers were prepared during the year and are awaiting publication :—

(1) Studies on the spotted bollworms of cotton—*Earias fabia* S and *Earias insulana* B—by M. C. Cherian and M. S. Kylasam.

(2) *Euborellia stali* Dhorn—a pest of groundnut (*Arachis hypogea*)—by M. C. Cherian and Muhammad Basheer.

(3) The fruit fly—*Dacus ferrugineus dorsalis* B and its status in South India—by M. C. Cherian and C. V. Sundaram.

(4) Notes on three predatory bugs of caterpillar pests of Daincha (*Sesbania aculeata*)—by M. C. Cherian and K. Brahmachari.

(5) Studies on *Diatraea venosata*—a Pyralid borer pest of sugarcane in South India—by M. C. Cherian and C. K. Subramaniyam.

(6) The host plants and associated parasites of the cotton stem weevil—*Pempheres affinis* Fst—of South India—by P. N. Krishna Ayyar.

(7) The rock bee honey—its extraction and preservation—by M. C. Cherian and S. Ramachandran.

(8) A note on the *Anophelene* mosquitoes of Coimbatore and its surroundings—by T. V. Subramaniyam.

The first six papers were presented at the Entomology section of the Indian Science Congress, held at Madras in January 1940.

XIII. Artists' Section.

I was in charge of the Artists' section throughout the year under report. The following items of work were executed—pen and ink drawings, graphs and charts 259; posters 141; paintings 280; labels 1,481; photographs 726; photo prints 2,243; lantern slides 270; bromide enlargements 491 and retouching negatives, prints, etc., 242.

XIV. Miscellaneous.

Sectional Meetings.—At the meetings of the staff short talks on the problems in which they are engaged, reviews of recent literature and accounts of the tours undertaken by the different members of the section were given.

University Examinations.—I was Examiner in Agricultural Zoology and Assistant Sri K. P. Anantanarayanan in Zoology for the B.Sc. Ag. degree examination.

Indian Central Cotton Committee Meeting.—I attended by special invitation the meetings of the Indian Central Cotton Committee held in January 1940 in Coimbatore.

Research Council.—I attended the meetings of the Research Council. As Secretary of the Council, I had to devote some time in correspondence with the district officers in charge of the Agricultural Research Stations regarding the Cropping Schemes.

Training in Entomology.—The following officers of the Mycological section were given training in Entomology during the year so as to enable them to attend to insect control work also in the districts—Messrs. C. S. Gopalaswami Rao, P. S. Suryanarayana Ayyar and K. Achyuthan Nambiar.

Exhibitions and shows.—Exhibits comprising of show cases, specimens of insect pests, posters, charts, lantern slides, bee-keeping appliances, etc., were sent on request for display at the following exhibitions :—(1) Indian Red Cross Society Exhibition, Coimbatore, (2) The Industrial Exhibition, Guntur, (3) The National Health and Baby Week Exhibition, Coimbatore, (4) The Karthigai Deepam Exhibition, Tiruvannamalai, (5) Exhibition at Calicut, (6) The All-India Khadi and Swadeshi Exhibition, Madras, (7) The Second Kistna District Agricultural and Industrial Exhibition, Vuyyuru, (8) The District Agricultural and Industrial Exhibition, Nellore, (9) Sri Ramakrishna Vidyalaya Exhibition, Perianaickenpalayam, (10) The All-India Swadeshi and Industrial Exhibition, Madura, (11) The Agricultural Exhibition, Tiruppur, (12) Health and Baby Week Exhibition, Erode and (13) The College Day and Conference Exhibition, Coimbatore. In addition, the following institutions were also supplied with bee-keeping exhibits—(1) The Central Industrial Museum, Madras, (2) The District Commercial Museum, Calicut, (3) Rural Development Van, Salem.

COIMBATORE,
5th August 1940.

M. C. CHERIAN,
Government Entomologist.

ADMINISTRATION REPORT OF THE GOVERNMENT MYCOLOGIST FOR THE YEAR 1939–40.

I was in charge of the Mycological section and the Microtome section throughout the year except for a period of three months from 11th March to 10th June 1940.

The activities of the section are classified under the following heads :—

(i) Mycological Research.

(ii) Virus disease investigations.

(iii) Advisory work.

(iv) Quarantine service and legislative measures.

(v) Propaganda.

(vi) Teaching.

(vii) Microtomy.

I. Mycological Research.

The following are the main items of research :—

1. *Rice—' blast '—Piricularia oryzæ.*

(*a*) *Studies in varietal resistance.*—Forty-two strains of rice consisting of twenty-nine departmental strains and thirteen selections supplied by the Paddy Specialist were taken up for studying their relative resistance to *Piricularia oryzæ* under field conditions in Coimbatore Central Farm. To ensure favourable conditions for infection, these varieties were planted in rows alternating with Adt. 10, a very susceptible variety. The belt of outskirts also consisted of the susceptible Adt. 10. Periodical observations were made and the amount of leaf, node and neck infection for these forty-two varieties was recorded. The following tabular statement gives the degree of infection in each strain based on the records of neck attack :—

Serial number and variety of rice.	Duration in days (sowing to harvest).	Percentage of neck infection.
1 Co. 4	192	Nil
2 11348	165	0·8
3 Co. 11	185	1·9
4 10998	165	3·3
5 Adt. 17	165	4·3
6 T. 392	180	4·6
7 Adt. 6	220	5·5
8 11340	165	5·6
9 Co. 8	190	6·4
10 Mtu. 5	200	7·2

Serial number and variety of rice.	Duration in days (sowing to harvest).	Percentage of neck infection.
11 G.E.B. 24	149	8·6
12 T. 256	164	8·9
13 Co. 1	155	9·8
14 Co. 6	176	12·0
15 Adt. 7	220	12·1
16 Adt. 8	150	12·6
17 5782	156	13 8
18 Co. 12	190	15·4
19 5780	156	16·3
20 10783	165	18·3
21 5781	156	19·7
22 Adt. 16	115	20·2
23 5783	156	23·1
24 Adt. 13	160	27·1
25 Co. 3	161	27·2
26 Adt. 12	107	28·7
27 Mtu. 12	210	29·5
28 5143	107	29·9
29 Co. 5	164	32·6
30 Co. 2	157	35·8
31 10905	160	37 5
32 Adt. 15	110	38·7
33 Co. 7	157	40·8
34 Mtu. 9	120	44·5
35 Adt. 19	109	49·2
36 Adt. 14	115	54·7
37 Co. 10	125	58·2
38 Mtu. 13	204	59·8
39 Adt. 18	121	61·3
40 Adt. 10	165	65·4
41 Co. 9	116	68·1
42 5109	107	70·9

Of the 42 strains studied, Co. 4 was found to be the most resistant. The new selections 11,348 and 10,998 obtained from crosses of Adt. 10 and G.E.B. 24 are also very promising.

Varietal resistance in relation to period of sowing.—Ten varieties of paddy consisting of three susceptible strains (Adt. 3, Mtu. 9 and

Co. 9), four moderately resistant strains (Co. 2, Co. 5, Co. 7 and Mtu. 5) and three resistant strains (Co. 4, Co. 11 and Adt. 6) were selected for this field experiment. The following tabular statement gives the infection recorded for each variety :—

Serial number and variety of rice.	Duration.	Percentage of neck infection.		
		September planting.	October planting.	November planting.
1 Co. 2	157	43·0	50·6	3·6
2 Co. 4	192	0·5	Nil	Nil
3 Co. 5	164	25·2	33·3	1·8
4 Co. 7	157	45·5	48·8	2·1
5 Co. 9	116	54·7	68·6	5·1
6 Co. 11	185	9·3	26·1	1·0
7 Adt. 3	90	56·2	40·8	9·8
8 Adt. 6	220	7·6	3·3	Not yet flowered (being season bound).
9 Mtu. 5	200	31·6	6·1	1·1
10 Mtu. 9	120	59·4	36·8	3·4

The highest incidence of disease was found in the October planting, Co. 4 remaining resistant in all the plantings. Adt. 6 which was found to be the most resistant last year is found to be less resistant than Co. 4. The incidence of disease was very low in the November planting even in the case of the susceptible varieties, thus confirming the observations made last year about November planting.

Viability of Piricularia oryzæ.—The fungus in diseased specimens of rice collected and preserved in the laboratory was found viable over a period of fifteen months.

2. *Helminthosporiose of cereals.*

(*a*) *Rice—Helminthosporium oryzæ—Studies on sporulation.*—The fungus does not sporulate well in most of the usual culture media such as quaker oats and French bean agars. The fungus was therefore cultivated on (1) potato dextrose agar, (2) potato dextrose plus tannic acid and agar, (3) cornmeal sand medium, (4) rice husk, (5) rice husk with 2 per cent dextrose and (6) malt agar. Flasks and tubes containing these media were inoculated with *Helminthosporium oryzæ* and examined after seven days. Good sporulation was obtained in cornmeal sand medium and in potato dextrose with tannic acid.

Another observation made during the progress of the work was that there was better sporulation in Petri dish cultures than in tube cultures indicating that a thinner medium induced better sporulation. To ascertain this point, Petri dishes having potato dextrose agar varying from 7·5 cc. to 20 cc. were inoculated and observed for spore formation. It was found that there was better sporulation in dishes with 7·5 cc. and 10 cc. of medium than in those with 15 cc. and 20 cc. of medium.

Sporulation in relation to humidity.—Cultures of the fungus kept at humidities of 66 per cent, 84 per cent, 95 per cent and

100 per cent respectively did not show any difference in their capacity for sporulation.

(*b*) *Toxin production.*—To see whether any toxins injurious to seedlings were produced by the organism, filtrates were obtained at four day intervals from liquid cultures of the fungus. Rice and cotton seedlings were placed in these filtrates and compared with those placed in sterile culture solution and in distilled water. No toxic effect was noticed in any of the seedlings showing that no toxins are produced during the growth of the organism.

(*c*) *Nature of enzymes produced by different species of Helminthosporium.*—Four species of Helminthosporium (*H. oryzæ, H. tetramera, H. sativum and Helminthosporium sp.* from ragi) were grown in various differential media to ascertain the nature of the enzymes produced by each of those organisms.

Amidase.—All the four species of *Helminthosporium* were grown in asparagin rosolic acid agar. Reddening of the medium was observed within forty-eight hours and after a week the reddening had spread throughout the medium in all the plates indicating the production of amidase by all the four species.

Diastase.—The four species were grown in starch agar and after a week's growth, the plates were flooded with 1 per cent iodine solution. No blue colouration was seen in the area covered by the growth of the fungi thus indicating that the starch there has been utilized by secretion of diastase by all the four species.

Erepsin.—When these four species were grown in casein agar plates a clear halo was seen under the growth indicating production of erepsin.

Lipase.—Litmus cream agar was used for testing the production of lipase. After a week's growth, it was found that the blue colour of the medium had become red only in the case of *H. oryzæ* and *H. sativum* and not in the case of *H. tetramera* and *Helminthosporium sp.* from ragi, thus showing that lipase is secreted only by *H. oryzæ* and *H. sativum* and not in the other two species.

Oxidase.—Potato dextrose agar with 0·125 per cent tannic acid was used for the cultivation of these organisms to ascertain their capacity for production of oxidase. Though all the four species produced oxidase, the maximum amount was found in *H. oryzæ* and the least in the species from ragi.

Emulsin.—All the four species were found to grow well in salicin agar medium thus indicating the production of emulsin.

Inulase.—Growth in inulin agar showed that inulase production was good only in *H. oryzæ and H. sativum.* In the other two species the enzyme was secreted only sparingly, *H. tetramera* producing the least.

It will be found from the above studies that *H. oryzæ* and *H. sativum* are more active in the secretion of these enzymes than the other two species.

(*d*) *Pathogenicity.*—Ten weeks old rice seedlings were inoculated with *H. oryzæ* on leaf blades and leaf axils and were kept inside inoculation cages. Discolouration at the seat of inoculation was evident within 24–36 hours. After the spots had well developed, the plants were taken out of the cages and kept outside. The infected spots were not found to spread any further indicating that a humid atmosphere was necessary for the spread of infection.

Rice seedlings, 15 days, 30 days and 45 days old were inoculated with *H. oryzæ* on the stem, leaf axil and leaf blade and kept inside inoculation cages. It was found that the amount of infection in leaf axils and leaf blades was 80–90 per cent while in the stems, it was only 30–40 per cent. It was also observed that the difference in the age of the seedlings had no significant influence on the amount of infection obtained.

Inoculations of 30 days old seedlings of different varieties of rice (Mtu. 1, 2, 3, 5, 6, 11 and 12) showed that all the varieties tried were equally susceptible.

Cross inoculations with H. oryzæ.—Inoculations of wheat and tenai seedlings showed that these take infection as readily as rice seedlings. Ragi and maize seedlings showed only a very small percentage of infection. Cumbu and sorghum seedlings did not take infection. Wound inoculations of seedlings of ragi, maize, sorghum and cumbu however were completely successful.

The following plants and earheads were also inoculated. Rice leaves and earheads, wheat leaves and earheads, barley leaves and earheads, tenai leaves and earheads, oat leaves and earheads, ragi leaves and earheads and well grown plants of cumbu, sorghum and maize without earheads. Successful infection was obtained in rice leaves and earheads, tenai leaves and earheads and wheat and barley leaves and earheads. Oat, ragi and maize showed a few cases of leaf infection only. Cumbu and sorghum did not take infection. Wound inoculations gave successful infection in all cases. The controls were all free from infection.

Soil and seed inoculations.—Three series of experiments were carried out. In the first series healthy seeds of rice were artificially infected with *H. oryzæ* and then sown in sterilized soil. In the second series, healthy seeds were sown in artificially infected soil. In the third series artificially infected seeds were sown in infected soil.

The following statement gives the percentage of infection obtained :—

Variety of rice.	Percentage of infection.			
	Infected seeds.	Infected soil.	Infected seed and soil.	Infection in control.
Mtu. 5	14·0	14·0	25·0	Nil.
Mtu. 7	18·0	20·0	33·0	Nil.
Mtu. 11	20·0	18·0	33·0	Nil.

It will be seen from the above that both the seed and the soil can be sources of infection and that the maximum amount of infection is produced when both the seed and soil are infected.

In all these experiments, the phase of the disease known as 'seedling blight' has never been found as none of the seedlings showing diseased spots on the leaves and stems was ever killed.

Thermal death point of H. oryzæ.—The thermal death point was found to be about 51°C for an exposure of 10 minutes and about 52°C for 5 minutes. Rice seeds are not killed by immersion in hot water of 55° to 57°C for 15 minutes. Previous experiments in this laboratory have shown that rice seeds can stand an exposure of 30 minutes at 56°C. This is in conformity with the recommendation of hot water treatment at 53°C for 10 minutes in Japan where the seedling blight is severe.

3. *Rice—False smut—Ustilaginoidea virens.*

The fungus was brought into pure culture from specimens obtained in the Central Farm. Comparative cultural studies of the fungus in quaker oats agar, French bean agar and Richards' medium agar were made. Quaker oats agar was found to give the best growth.

4. *Ragi—Blast—Piricularia sp.*

Incidence of disease under field conditions.—The disease was not prevalent to any serious extent on account of the bright weather that prevailed during the heading period. Though a few cases of leaf attack were found, the infection was not found to spread to the earheads. The duration of the crop was from May to September.

Incidence of blast in relation to time of sowing.—To ascertain the incidence of disease in relation to the time of sowing, twelve varieties of ragi ranging in duration from 105 to 135 days were sown every month from January to December and the amount of earhead infection recorded. The severity of the disease depends on the conditions of weather especially humidity and rainfall at the time of heading out of the crop. The following tabular statement gives the infection obtained and the relevant meteorological data during the period :—

Time of sowing (1939).	Time of harvest.	Amount of infection.	Mean relative humidity in month preceding harvest.	Rainfall in inches.	Number of rainy days.	Remarks.
			PER CENT.			
January ..	May	Nil.	67·9	0·63	4	
February ..	June	Nil.	64·8	0·08	1	
March ..	July	Nil.	67·1	1·3	3	
April ..	August ..	Nil.	70·7	3·1	6	
May	September ..	Light.	76·0	0·9	3	
June	October ..	Heavy (39 per cent to 81 per cent).	82·8	12·19	12	
July	November ..	Heavy (33 per cent to 85 per cent).	84·6	4·81	6	
August ..	Do. ..	Heavy (69 per cent to 98 per cent).	84·6	4·81	6 *	* Premature harvest due to heavy infection.
September ..	January ..	Light.	73·4	Nil.	Nil.	
October ..	February ..	Do.	73·1	Nil.	Nil.	
November ..	March ..	Nil.	64·1	0·20	1	
December ..	April ..	Nil.	69·8	3·44	5	

It will be seen from the above records that the crops sown in June, July and August suffered heavy infection and the infection is related to the high humidity prevailing at the time of heading and maturity.

Varietal resistance.—Of the twelve varieties tried none of them was found to be resistant. Heaviest infection in all the varieties was found in the August sown crop. The counts show their susceptibility ranging from 69 per cent to 98 per cent infection.

Cross inoculations.—Inoculations were conducted on nine different host plants with Piricularia strains isolated from ragi, tenai and rice. The ragi and tenai strains were found to infect ragi, tenai, two strains of wheat, oat, barley, maize and *Dactyloctenium aegyptium* but not rice. The rice strain, *Piricularia oryzæ* was found to infect all these except ragi.

5. *Areca palm—Mahali—Phytophthora arecæ.*

The field experiment for the determination of the economic strengths of bordeaux mixture and the most suitable spreaders was being continued as there was no disease in the experimental area during the year 1938–39.

The year 1939–40 also was very unfavourable for the spread of *mahali* infection. Four gardens in four different villages in the Puttur taluk of South Kanara were selected for the spraying experiments. Though scattered cases of nutfall appeared in three of these gardens as early as the third week of June, the disease was not found to spread to any appreciable extent on account of the unusual monsoon conditions during the months of June and July. Apparently, the long intervals of bright weather during the infective period were unfavourable for the spread of infection. The observations of these plots had to be abandoned in October as the counts of nutfall taken so far showed a very low incidence of disease even in the control plots and as the figures did not yield any valuable data.

Another series of experiments was started in May 1940 on similar lines in Mundaji (South Kanara) where the disease has been reported to occur almost every year. Three gardens were selected each in a different part of the village. A total of 426

trees are under this experiment. The following tabular statement shows the treatment given in each garden :—

Serial number.	Mixture used.	Strength of mixture.	Spreader used.	Quantity of spreader used.	Kind of spray (mist or jet).
		PER CENT.			
1	Bordeaux.	2	Resin ..	8 lb. per 100 gallons ..	Mist.
2	Do.	1	Do. ..	Do. ..	Do.
3	Do.	2	Do. ..	4 lb. per 100 gallons ..	Do.
4	Do.	2	Do. ..	2 lb. per 100 gallons ..	Do.
5	Do.	2	Casein ..	Do. ..	Do.
6	Do.	1	Do. ..	Do. ..	Do.
7	Do.	2	Niger oil ..	½ gallon per 100 gallons ..	Do.
8	Do.	2	Do. ..	Do. ..	Jet.
9	Do.	1	Do. ..	Do. ..	Mist.
10	Do.	2	No adhesive ..	Nil.	Do.
11	Control	..	..	..	..

The results of this field experiment are awaited.

Oospore production in Phytophthora species—Oospore formation in single strain cultures.—Maize meal agar cultures of *Phytophthora parasitica* were found to produce oospores when incubated at 20°C. *Phytophthora meadii* also was found to produce a few oospores when incubated at 15°C. The other Phytophthoras did not produce any oospore either at 15° or at 20° C.

Shelled and unshelled arecanuts inoculated with *P. arecæ* and *P. palmivora* and incubated at 20°C. were not found to produce any oospores.

Oospore formation in paired cultures.—The following paired cultures of Phytophthoras in maize meal agar plates were studied to find out the formation of oospores in such cultures at the laboratory temperature (27°–28°C.) :—

(1) Areca × palmivora.
(2) Areca × citrus.
(3) Areca × hevea.
(4) Areca × tobacco.
(5) Citrus × tobacco.
(6) Citrus × hevea.

Repeated examination of these cultures failed to show any oospores.

As these paired cultures were not found to produce any oospores, another series of maize meal agar plates were inoculated with the following combinations and incubated at 20°C. :—

(1) Areca × hevea.
(2) Areca × palmyra.
(3) Areca × citrus.
(4) Areca × tobacco.
(5) Tobacco × hevea.
(6) Palmyra × hevea.
(7) Palmyra × citrus.
(8) Palmyra × tobacco.
(9) Citrus × hevea.
(10) Citrus × tobacco.

Of these, the following combinations were found to produce oospores :—

Areca × *hevea.*—Oospores were found only in the hevea zone of contact between the two strains.

Areca × *citrus.*—Oospores were formed only at the zone of contact which showed aerial growth while the individual zones were all submerged.

Areca × *palmyra.*—Oospores were found in the zone of contact and in the areca zone but were not present in the palmyra zone.

P. arecæ × *P. parasitica.*—Oospores were found both in the *arecæ and parasitica* zones.

From a study of the paired cultures of the *palmivora* group, it has been found that oospores were produced only from areca and hevea strains, the citrus and *palmivora* strains not producing any.

The oospores of *P. meadii* are found only on pairing with *P. arecæ* and those of *P. arecæ* on pairing with palmyra and citrus strains.

Influence of Trichoderma filtrate on formation of oospores.—Addition of filtrate of *Trichoderma lignorum* was not found to facilitate oospore formation.

Influence of Areca Phytophthora filtrate on production of oospores.—Maize meal agar with the addition of a filtrate obtained from liquid cultures of areca *Phytophthora* was prepared and Petri dishes containing this special medium were inoculated with *Phytophthora* species from areca, citrus, hevea, palmyra and tobacco and incubated at 20°C. None of the species showed any oospore production.

Enzyme production in Phytophthora species.—Areca, palmyra, citrus, hevea and tobacco Phytophthoras were grown in the following special agar media to find out the nature of the enzymes produced :—

(1) litmus cream agar,

(2) casein agar,

(3) egg albumen agar, and

(4) malt agar with 0·5 per cent tannic acid.

The Phytophthora species were found to grow well only in litmus cream agar changing the colour of the medium to red indicating the production of lipase. The failure of growth in casein and albumen agars indicates that the enzymes trypsin and erepsin are not produced. In the tannic acid medium, though

there was some growth, the brown discolouration characteristic of oxidation with the aid of oxidase was not evident.

Inoculations with Phytophthora species—Agave wightii.—Wound inoculations on leaves of *Agave wightii* with Phytophthora species from areca, hevea, citrus, palmyra, castor and tobacco gave infection only in the case of areca, hevea, citrus, castor and tobacco Phytophthoras. No infection was obtained with *P. palmivora.*

Arecanuts about six months old inoculated with an old and a new strain of *P. arecæ* gave infection in the case of the new strain only. Arecanuts inoculated with *P. meadii, P. palmivora* and *P. parasitica* did not produce any infection.

Arecanuts about five months old were inoculated with the two isolations of *P. arecæ, P. meadii* and *P. palmivora.* Positive infection was obtained with both the strains of *P. areacæ* and also with *P. meadii.* There was no infection with *P. palmivora.*

Cocoa fruits wounded as well as unwounded were inoculated with *Phytophthora arecæ.* The wound inoculations were quite successful the infection spreading over half the fruit in two weeks and over three-fourths in three weeks. Inoculations on unwounded fruits showed slight growth only at the seat of inoculation accompanied by darkening of the rind but without any rotting of the inside tissue even after three weeks.

Fresh isolations of Phytophthora species.—Two new isolations of Phytophthora species were made during the year. The strain of *P. palmivora* from coconut was obtained from a bud-rot affected coconut from Malabar. Another species agreeing with *P. palmivora* was also isolated from diseased citrus roots from Bezwada. These cultures are maintained for further study.

6. *Gloeosporium disease of arecanuts.*

The manurial and spraying trials did not give any significant results. The experiment is being repeated. The only change made this year is to increase the quantity of manure applied, to two pounds per tree.

7. *Red gram—Wilt—Fusarium vasinfectum.*

As pot experiments have given indications of control of wilt when red gram seeds are treated with ceresan a field experiment has been laid out in field No. 7 of the cotton station where the disease has been noted to have been severe in previous years.

Varietal resistance trials.—To study the resistance of various red gram varieties to wilt, 54 selections are under field trial in duplicated and randomized plots. The work is being done with the co-operation of the Cotton Specialist.

8. *Groundnut—Wilt—Macrophomina phaseoli.*

Field experiments for the study of wilt are being conducted in collaboration with the Oil Seeds Specialist.

Soil and seed treatments for control of wilt.—The scheme of field experiments laid out in the Agricultural Research Station at Tindivanam did not give any definite indications as to the efficacy of the various treatments tried. The maximum amount of disease even in the untreated control plots was only 6·9 per cent. The experiment has been repeated with some modifications and the results are awaited.

Varietal resistance.—To find out the resistance of some of the important strains of groundnut to wilt a field experiment was laid out at the Agricultural Research Station at Tindivanam with nine spreading types and ten bunch types. The incidence of wilt in these has not been high and the maximum infection obtained being 16·3 per cent in A.H. 811. None of the varieties tried has shown any outstanding qualities of resistance. The experiment has been repeated with ten bunch varieties and ten spreading varieties. The incidence of disease has been very high this year, A.H. 73, a spreading type giving as high as 63·5 per cent infection. Only one bunch variety A.H. 53 is showing a comparatively high degree of resistance. Further observations are being made.

Incidence of wilt in relation to time of sowing.—Another set of experiments has been started this year to ascertain the incidence of wilt in relation to the time of sowing. For this trial a susceptible Mozambique bunch variety A.H. 42 was sown in quadruplicate series during March 1940. The sowings were repeated in April, May and June. Observations are in progress.

9. *Sugarcane—Red rot—Colletotrichum falcatum.*

Pathogenicity.—Two strains of the fungus were inoculated on sugarcane varieties of poovan, Co. 419 and Co. 421, *Saccharum spontaneum* (local), *S. spontaneum* (Galagah) and leaves of maize and *Arundo donax*. The sugarcane varieties and *S. spontaneum* varieties and wounded leaves of maize were successfully infected. Wounded leaves of *Arundo donax* were not infected.

Method of infection.—Setts of Co. 419 and Co. 281 were inoculated as follows and planted in pots : (1) Inoculating through bores, (2) mixing the soil with cultures of the fungus, (3) smearing the cut ends, and (4) smearing the root bands with the inoculum. At the end of two months it was found in Co. 419, 6 out of 18 shoots inoculated through bores and 6 out of 25 shoots in soil inoculation series had developed symptoms of infection. Co. 281 was found to be resistant.

Influence of temperature on the spread of infection within infected setts.—Sugarcane setts were inoculated and kept at temperatures varying from 15°C. to 34°C. It was found that strain

No. 1 spreads more than strain No. 2 at all temperatures. The maximum spread was found to be between 30°C. and 34°C. At 15°C there was very little spread and there was gradual increase with the rise in temperature. The spread is quicker in top setts than in the bottom setts at all temperatures.

Thermal death point.—The spores of both the strains are killed by an exposure of five minutes at about 51°C. The appressoria of the fungus however are not killed at this temperature for the same exposure.

Enzyme production.—The enzymes amidase, lipase, inulase, erepsin and trypsin were found to be secreted when the two strains were grown in special differential media. The enzyme emulsin was not produced in strain No. 2 and only a trace of it was found in strain No. 1.

10. *Sorghum—Leaf spot—Colletotrichum graminicolum.*

The fungus was isolated from sorghum leaves. Successful inoculations were made on leaves of sorghum seedlings and wounded midrib of sugarcane leaves. The time taken for infection of sorghum leaves varies from six to fourteen days according to temperature conditions.

11. *Cotton—Seedling blight and boll rot—Colletotrichum indicum.*

Pathogenicity.—Infection studies show that the fungus penetrates the cotyledons both through the stomata and by piercing through the outer wall of the epidermis. In the collar region penetration is through the epiderman wall. The penetration takes place in about 18 hours after inoculation.

Soil infection.—Cultures of the fungus were mixed with sterilized soil in pots. These were then sown with surface sterilized H-1 cotton seeds. Within a week after emergence, all the seedlings were killed. When the pots were resown after a month, 66 per cent of the seedlings were killed.

Infection in relation to temperature.—Inoculated seeds were sown in pots with sterilized soil and kept at different temperatures ranging from 15°C to 34°C. The maximum amount of infection was obtained between 20°C. and 30°C.

Cross inoculations.—Seedlings of *Gossypium stocksii. G. harknessii, G. armourianum* and *G. Davidsonii* were inoculated. On *G. stocksii* alone there was discolouration at the collar region but there was no mortality or further spread. A cross between *G. hirsutum* and *G. arboreum* did not take infection. *Aristolochia bracteata* leaves were inoculated successfully.

Germination of infected seeds.—The germination of delinted cotton seeds soaked in spore suspensions were found to be very seriously affected. Only one per cent of the seeds germinated while the controls gave 37 per cent germination.

Seed treatment.—The effect of seed treatment with ceresan on the incidence of disease in artificially infected seeds was tested in germination trays, pots and small plots. Seeds were first infected and then dry dressed with ceresan. The treatment was found to be very successful in controlling seed infection, the germination and survival percentages approximating those of healthy and normal seeds. The treatment with ceresan was however not successful in controlling soil infection when there were heavy rains at the time of sowing. When there are no rains, the treated seeds give good results while the controls give a poor stand.

Infection in relation to the water content of the soil.—The moisture holding capacity of potting earth was determined and a series of pots containing soil with different percentages of moisture were prepared. Healthy and infected seeds were sown in these pots and kept inside cages. The pots were weighed every day and the deficiency made up by the addition of distilled water. The following table gives the germination and infection obtained :—

Percentage of moisture in soil.	Treatment.	Percentage of germination.	Percentage of disease.
10	Inoculated	Nil.	Nil.
,,	Control	Nil.	Nil.
20	Inoculated	Nil.	Nil.
,,	Control	Nil.	Nil.
30	Inoculated	22	100
,,	Control	25	Nil.
40	Inoculated	44	100
,,	Control	68	Nil.
50	Inoculated	48	100
,,	Control	76	Nil.
60	Inoculated	66	40
,,	Control	66	Nil.
70	Inoculated	3	Nil.
,,	Control	20	Nil.

Fifty per cent soil moisture was found to be the optimum for germination. The highest incidence of disease is found in soils containing from 30 per cent to 50 per cent moisture.

Toxin production.—Seedlings placed in filtrate of two days old liquid cultures became flaccid in 24 hours. Filtrates from four-day and six-day old cultures produced wilting in 24 hours while the filtrate from ten-day old cultures produced drying of the cotyledonary margins in addition to wilting. In four-weeks old filtrates drying and wilting occurred in 12 hours. The controls in all these experiments were quite healthy. The toxic effect is thus found to increase with the age of the culture. Boiled filtrates were not found to be toxic showing that the toxin is not thermostable.

Enzyme production.—The production of amidase, lipase, erepsin, trypsin and small quantities of emulsin and inulase was noted.

Comparative studies of Colletotrichum indicum with other strains and species of Colletotrichum.—Isolations of Colletotrichum from chilli, Aristolochia and local cotton were brought into pure culture and compared with *C. indicum.* The first attempt at inoculation of the chilli fungus (*C. capsici*) on cotton seedlings was not successful. The fungus was then grown on sterilized cotton seeds and as this culture gave 66 per cent infection, this was used for further inoculations. The following statement gives the results of inoculation of H. 1 cotton seedlings with the four isolations of Colletotrichum :—

Inoculum.	Number inoculated.	Number of seedlings dead on						
		5th day.	6th day.	7th day.	8 day	9th day.	10th day.	11th day.
C. indicum	11	11	..	..	..	..	..	..
C. capsici	14	7	11	13	14	..	..	..
C. sp. (Aristolochia). ..	14	1	2	4	6	10	11	14
C. sp. (local cotton) ..	11	11	..	..	..	..	..	..
Control	10	All healthy.						

All the four strains are found to infect cotton seedlings and some are more virulent than the others.

12. *Citrus—Leaf fall, fruit rot and canker—Phytophthora sp.*

Field experiments for control.—The data obtained during the course of the experiment were analyzed. The incidence of disease was evaluated by the quantity of leaf fall per plot. The yield was estimated by the number of saleable fruits obtained per tree and per plot. The analysis of variance was worked out and the F value determined. The following table gives the results :—

Mixture used.	Time of spraying.	Number of trees per treatment.	Amount of leaf fall due to disease.	Amount of fruit fall due to disease.	Yield of marketable fruits.
One per cent Bordeaux mixture.	One premonsoon spray (late May).	75	42,413	288	15,107
Do.	One monsoon spray (late July).	75	12,592	Nil.	17,315
Do.	Two sprayings, one premonsoon and one monsoon.	75	10,446	Nil.	24,096
	Control	75	84,095	535	13,106

The results show that—

(1) spraying was very effective in controlling the leaf fall;

(2) a single spraying after the onset of the monsoon and just at the time the first signs of disease are noticed (late July) was more effective than a single spraying just before the onset of the monsoon (late May);

(3) two sprayings were not significantly more beneficial than the single spraying given in July as regards leaf and fruit fall; and .. ..

(4) the total yield of the twice-sprayed plots was significantly higher than those of all other plots.

The spraying experiments have been repeated and observations are in progress.

13. *Ginger Rhizome rot—Pythium spp.*

Field experiments.—The results of the soil and seed treatments showed that soil treatments were not effective in controlling the disease. In the seed treatment series, ceresan was found to control the disease more effectively than the other treatments. The experiments laid out to ascertain the best treatment for the preservation of seed ginger in pits again showed that treatment with 0·1 per cent mercuric chloride for 1½ hours was the most effective in reducing loss during storage without in any way impairing the sprouting capacity of the seed ginger.

As soil treatments had not been effective in controlling the disease, these were given up this year and the field trials have now been confined to seed treatments only. These series of experiments are now laid out in three different places in Malabar. The following are the treatments under trial :—

(1) Mercuric chloride solution (0·1 per cent for 1½ hours) before storage.
(2) Mercuric chloride solution (0·1 per cent for 1½ hours) before planting.
(3) Mercuric chloride solution (0·1 per cent for 1½ hours) before storage and again before planting.
(4) Ceresan solution (0·25 per cent for half hour) before storage.
(5) Ceresan solution (0·25 per cent for half hour) before planting.
(6) Ceresan solution (0·25 per cent for half hour) before storage and again before planting.
(7) Agrosan G solution (0·25 per cent for half hour) before planting.
(8) Control.

II. Virus Diseases.

1. *Sugarcane—Mosaic—Varietal resistance trials.*—The annual field trials to estimate the relative resistance of sugarcane varieties to mosaic disease were continued. Sixteen varieties were included in the trial and the following statement gives the incidence of disease in each of these varieties :—

Serial number and variety tried	Percentage of infection.	Number of years the variety has been under trial.
1 Co. 205 Pusa	Nil.	7
2 Co. 213	78·3	7
3 Uba. (S.H. 38)	Nil.	2
4 Uba. (S.H. 281)	Nil.	2
5 Co. 360	60·9	7
6 Co. 361	44·7	7

Serial number and variety tried.	Percentage of infection.	Number of years the variety has been under trial.
7 Co. 411	Nil.	3
8 Co. 415	9·3	3
9 Co. 421	8·0	2
10 Co. 422	Nil.	2
11 Co. 432	4·5	2
12 Co. 434	Nil.	4
13 Co. 438	52 5	2
14 Co. 439	24·7	2
15 Co. 443	2·8	2
16 Co. 513	67·7	2

Co. 205 (Pusa) and Co. 434 continued to show resistance as in previous years. Uba (S.H. 38) and Co. 422 have been quite free during the two years they have been under trial. The progress of secondary infection was not so rapid as in previous years, the maximum infection being 78·3 per cent in Co. 213.

Insect transmission.—Transmission experiments with *Aphis maidis* and *Toxoptera graminis* were tried without any success so far.

2. *Cotton—Sterility disease.*—The disease has been noticed during the year in the Coimbatore Cotton Breeding Station in indigenous types. Two species of jassids were found feeding on these cotton plants. Transmission experiments with both the species of insects did not give any successful results.

Transmission through grafting.—At Hagari and Adoni preliminary transmission experiments with a total of 50 plants have given promising results. Three cases of transmission at Hagari and two at Adoni were obtained as a result of grafting diseased scions on healthy stocks.

3. *Tobacco—Ring spot.*—The disease was noticed in Coimbatore and was successfully transferred to *Nicotiana glutinosa* and *tobacco*. It was however found that the symptoms disappeared later and the new leaves from the inoculated plant did not prove infective.

4. *Brinjal—" Little leaf."*—The disease was successfully transmitted through grafting to the following additional hosts :—

(1) *Withania somnifera.*
(2) *Solanum tuberosum.*
(3) *Solanum pubescens.*
(4) *Solanum seaforthianum.*

Insect transmission.—Eutettix phycitis was not able to transmit the disease to tomato, tree tomato, tobacco and *Physalis peruviana*. The insect however was able to transmit the disease to *Solanum xanthocarpum, Solanum trilobatum* and *Datura fastuosa.*

5. *Cardamom mosaic.*—Transmission experiments with thrips (*Taeniothrips cardamomi*) as vectors were not successful.

III. Advisory Work.

One hundred and sixteen specimens of diseased plants received for examination and technical advice were attended to during the year. Besides these several enquiries relating to plant pathological problems were also dealt with by correspondence.

IV. Quarantine Service and Legislative Measures.

Thirty-one consignments of plants and seeds were examined or fumigated. Samples from sixteen consignments of tamarind meant for export to Egypt were examined and necessary certificates issued.

The Agricultural Pests and Diseases Act of 1919 continued to be in force during the year in respect of the bud rot disease of palmyra and coconut palms in East Godavari, West Godavari, Kistna and Guntur districts and in the Palghat, Walluvanad and Ponnani taluks of Malabar. A sub-assistant in mycology and a special revenue inspector continued to be in charge of the special work in South Malabar. In addition to these, three demonstration maistris, one for each taluk, were appointed to help the Agricultural subordinates in their work.

The statement below relating to these three taluks shows that the contribution of the village officers towards tracing diseased trees is still insignificant :—

Taluk.	Balance left over at the end of May 1939.	Number of trees traced out between June 1939 and May 1940.	
		By the village officers.	By the Agricultural Department staff.
Palghat	64	495	2,135
Walluvanad	101	99	1,395
Ponnani	94	37	1,014
Total ..	259	631	4,544

It is hoped that the Government's recent acceptance of the recommendations of the Deputy Director of Agriculture, IV Circle, and myself regarding the need for the submission of separate returns by the village officers and the Agricultural departmental officers will go a long way to remedy the defect.

The special staff appointed to deal with the extensive spread of bud rot of palmyra palms in parts of Kovvur, Tanuku, Narsapur, Pithapur, Cocanada, Ramachandrapur and Razole taluks have been doing useful work.

V. Propaganda.

Mycological exhibits consisting of attractive posters, charts and specimens were displayed in the following exhibitions :—

(1) Agricultural exhibition during the College Day and Conference at Coimbatore.

(2) All-India Khadi and Swadeshi Exhibition at Calicut.

(3) All-India Khadi and Swadeshi Exhibition at Madras.

(4) District Agricultural and Industrial Exhibition at Nellore.

(5) Agricultural exhibition during the cattle show at Tiruppur.

(6) Agricultural exhibition during the health and baby week at Erode.

Propaganda through radio.—An article in Tamil on " Plant diseases and their control " was sent for radio talk.

VI. Teaching.

Thirty-five lectures in mycology and plant pathology were delivered to the students of B.Sc. (Ag.) III, and thirty practical classes conducted. Thirteen lectures on horticulture with eight practical classes were given to the same class. A short course on plant diseases and their control was conducted for the special short course students.

VII. Microtomy.

The microtome section continued to serve the needs of all the sections in the institute as well as the officers in the districts. The following figures sum up the main work carried out in the section :—

Materials received	503
Materials embedded	382
Number of blocks cut	368
Number of slides prepared	1,422
Number of slides stained	1,263
Number of slides mounted	1,258

Publications.

1. The present position of " Pollu " disease of pepper in Malabar—Paper read at the College Day and Conference—*Madras Agricultural Journal.*

2. Studies on the parasitism of *Colletotrichum indicum* Dast by T. S. Ramakrishnan—Presented at the Agricultural section of the Indian Science Congress, 1940, and subsequently sent for publication in the *Indian Journal of Agricultural Science.*

Training in Mycology.

Messrs. C. Krishnamurthy, N. Raghava Rao and E. R. Gopala Menon, Assistants in Entomology, were given training in mycology for three months. Sri R. Narasimhachari, Assistant Agricultural Demonstrator in Entomology is undergoing training in mycology from 5th June 1940.

Acknowledgments.

My thanks are due to all my colleagues at Coimbatore and the districts for ungrudging help and cordial co-operation. To the staff of the section I acknowledge their loyal service and devotion to duty.

COIMBATORE,
30*th July* 1940.

K. M. THOMAS,
Government Mycologist.